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6480.8A

MAINTENANCE OF AIRPORT TRAFFIC CONTROL TOWERS

October 16, 1992

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

Distribution: Selected Airway Facilities Field and Regional Offices; ZAF-607

Initiated By: AOS-220

FOREWORD

1. PURPOSE.

a. This order provides guidance and prescribes technical standards and tolerances, and procedures applicable to the maintenance and inspection of airport traffic control towers (ATCT). It also provides information on special methods and techniques that will enable maintenance personnel to achieve optimum performance from the equipment. This information augments information available in instruction books and other handbooks and complements Order 6000.15B, General Maintenance Handbook for Airway Facilities.

b. This revision implements Configuration Control Decision (CCD) N14488, Revise Maintenance of Airport Traffic Control Towers.

2. DISTRIBUTION.

This directive is distributed to selected offices and services within Washington headquarters, the FAA Technical Center, the Mike Monroney Aeronautical Center, regional Airway Facilities divisions, and AF field offices having the following facilities/equipment: TOWB; ATCT.

3. CANCELLATION.

Order 6480.8, Maintenance of Airport Traffic Control Towers, is canceled.

4. MAJOR CHANGES.

This revision combines all appendixes into a common order applying to all ATCT's. The material is updated, and field comments are incorporated throughout the handbook.

5. MAINTENANCE AND MODIFICATION POLICY.

a. Order 6000.15B, this handbook, and the applicable equipment instruction books shall be consulted and used together by the maintenance technician in all duties and activities for the maintenance of FAA-owned or maintained airport traffic control towers. If the specific ATCT equipment is not listed in this handbook, use the appropriate handbook or instruction book to tailor the ATCT maintenance to the specific facility. These documents shall be considered collectively as the single official source of maintenance policy and direction authorized by the Operational Support Service. References located in the chapters of this handbook entitled Standards and Tolerances, Periodic Maintenance, and Maintenance Procedures shall indicate to the user whether this handbook and/or the equipment instruction book shall be consulted for a particular standard, key inspection element or performance parameter, performance check, maintenance task, or maintenance procedure.

b. Order 6032.1A, Modification to Ground Facilities, Systems, and Equipment in the National Airspace System, contains comprehensive policy and direction concerning the development, authorization, implementation, and recording of modifications to facilities, systems, and equipment in commissioned status. It supersedes all instructions published in earlier editions of maintenance technical handbooks and related directives.

6. FORMS.

In addition to forms required by Order 6000.15B, the following forms may be required to document maintenance activities.

a. FAA Form 6000-8, Technical Performance Record, Continuation or Temporary Record/Report Form, NSN 0052-00-686-0001, unit of issue: PD.

b. FAA Form 6930-1, Fire Extinguisher Maintenance Record, NSN 0052-00-055-3001, unit of issue: PD.

c. FAA Form 6930-2, Fire Extinguisher CO_2 Maintenance Record, NSN 0052-00-055-4001, unit of issue: PD.

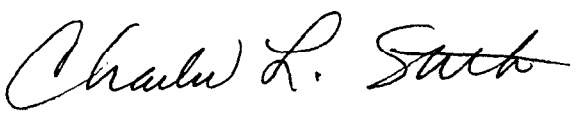
d. FAA Form 6980-5, Engine Generator, NSN 0052-00-697-0001, unit of issue: PD.

e. FAA Form 6980-6, Nickel-Cadmium-Alkaline Storage Battery Record, NSN 0052-00-898-0000, unit of issue: PD.

f. FAA Form 6980-7, Lead-Acid Storage Battery Record, NSN 0052-00-898-1000, unit of issue: PD.

7. RECOMMENDATIONS FOR IMPROVEMENT.

Preaddressed comment sheets are provided at the back of this handbook in accordance with Order 1320.40B, Expedited Clearance Procedures for Airway Facilities Maintenance Directives. Users are encouraged to submit recommendations for improvement.



Charles L. Stith
Director, Operational Support Service

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CHAPTER 1. GENERAL INFORMATION AND REQUIREMENTS

1. OBJECTIVE.

This handbook provides the necessary guidance, to be used in conjunction with information available in instruction books and other handbooks, for the proper maintenance of ATCT's.

2. SCOPE.

This handbook contains general information applicable to all FAA-owned or -maintained airport traffic control towers and system-oriented maintenance information applicable to specific ATCT equipment. This handbook establishes a maintenance program for all FAA-maintained airport traffic control towers (ATCT).

3. COORDINATION OF MAINTENANCE ACTIVITIES.

All ATCT maintenance activities shall be closely coordinated with air traffic control (ATC) personnel to preclude unanticipated interruption of services. Maintenance personnel shall be responsible for maintaining the equipment in an operational condition within the tolerances specified in chapter 3.

4. SAFETY.

a. **General.** The possibility of electrical shock, falls from elevated structures, and other hazards are ever present while performing maintenance. Therefore, be particularly mindful of these dangers and observe the safe practice recommendations listed in this order and in Order 6000.15B, General Maintenance Handbook for Airway Facilities.

b. **Heating, Ventilating, and Air-Conditioning (HVAC) Systems.** Personnel shall exercise care while working on HVAC system equipment. Particular care shall be exercised when high voltages are present; when refrigerants are handled; and when working on or around rotating machinery, piping systems, or on components containing heated or chilled water, steam, compressed air, fuel oil, or gases. Handling refrigerant must comply with the Environmental Protective Agency (EPA) Clean Air Act (CAA) guidelines.

c. **Electrical Equipment.** Personnel shall exercise care while servicing electrical equipment, particularly when high voltages are present. When inspection plates and dust covers are removed or access doors are open exposing internal wiring, special attention is required. Contact with ac or dc potentials can result in severe shock, burns, or loss of life.

5. PROVISIONS FOR PHYSICALLY HANDICAPPED.

Recently constructed base building facilities are designed in accordance with the provisions of the latest edition of the American National Standards Institute (ANSI) A117.7 to facilitate access. Shaft and cab designs are not required to comply to the standard; however, many of the handicapped type access features, such as nonslip floors and stairs, handrails, and color contrasts, have been incorporated in many ATCT structures.

6.-19. RESERVED.

CHAPTER 2. TECHNICAL CHARACTERISTICS

Section 1. GENERAL

20. OBJECTIVE.

This chapter provides a general description of the physical and functional characteristics of the various ATCT environmental systems. Instruction books and manufacturer's data should be consulted for more detailed information.

21. BASIC ATCT COMPONENTS.

ATCT facilities have three basic components: (a) control cab or cab, (b) tower shaft or shaft, and (c) base building. Each basic component is defined below.

a. Control Cab. The cab in one of the primary operating spaces of the control tower. The cab is elevated above ground level and physically oriented relative to the primary runway to obtain an unobstructed view of the airport operations area.

b. Tower Shaft. The tower shaft has two primary functions. It supports the raised cab and provides access to the cab with a stairway and/or elevator. A secondary function of the shaft may be to house ATCT functional space. Most tower shafts are structurally independent (free-standing).

c. Base Building. The base building is a single or multiple story building adjacent to the tower shaft. Its primary function is the provision of facility functional space. The base building is structurally independent but is usually attached to the tower shaft with an access corridor. There are several designs of base buildings, such as Leo A. Daly, Golemon and Rolfe Associates, Burns McDonnell, a regional design, or a design determined by the ATCT sponsor.

22. ATCT CLASSIFICATIONS.

a. Airport traffic control towers are classified into five main categories designated by an activity level number (I, II, III, IV, V) and a letter (a, b, c, d), if applicable, to indicate a subdivision of that level. These levels are based upon the quantity and type (VFR or IFR) of air traffic controlled by the ATCT. The volume figure used to distinguish between levels of ATCT's is the total of annual airport operations, annual instrument operations, or combinations of these two counts. The FAA numerical volume ranges and corresponding activity level numbers are listed in table 2-1. This distinction in levels has been established by the Air Traffic Service; however, it is generally used throughout the FAA. This activity level classification system is used to categorize ATCT's.

b. The Airway Facilities design classification level differs from the Air Traffic activity level. The Airway Facilities activity levels are as follows:

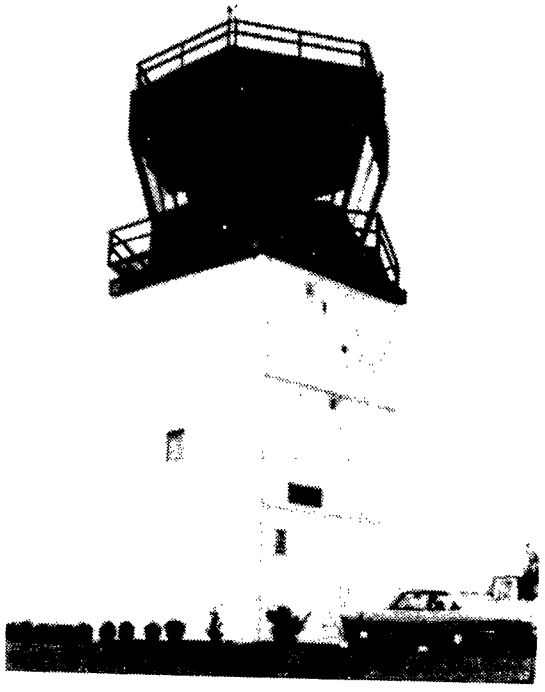
LAL - Low Activity Level
LAR - Low Activity Radar
MAL - Major Activity Level
IAR - Intermediate Activity Radar
IAL - Intermediate Activity Level
MAR - Major Activity Radar

23. BASIC ATCT DESIGNS.

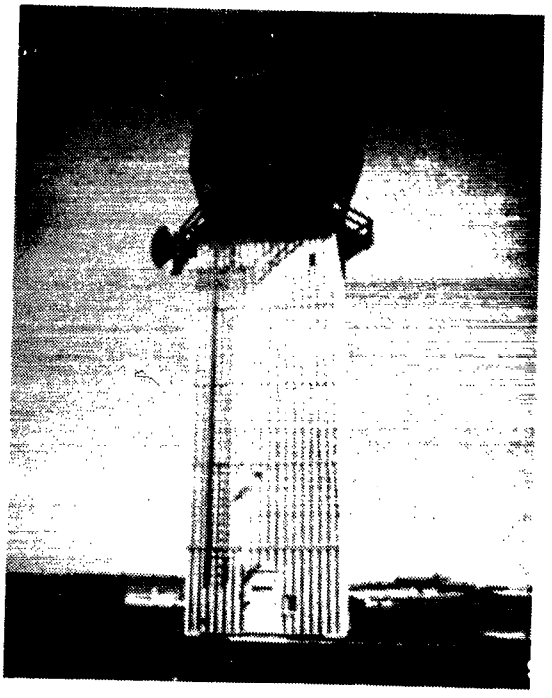
The three basic components of an ATCT are the tower cab, the tower shaft, and the base building. They can be combined in various ways to provide one of the following basic configurations: (1) freestanding functional shaft, (2) base building and functional shaft, and (3) base building and nonfunctional shaft. The tremendous diversity of site layouts at ATCT facilities and the various levels of activity indicate some of the variables controlling the ATCT design. A tower cab must have sufficient height to provide an unobstructed view of the airport runways and taxicabs. A base building is required if the tower shaft does not contain enough space to accommodate all of the operational equipment and the administrative and training requirements of the ATCT. Figures 2-1 through 2-3 illustrate ATCT designs currently in use that represent these basic configurations. Figure 2-4 is a typical I.M. Pei designed ATCT, and figure 2-5 is a current Leo A. Daly major activity tower with a functional shaft and a TRACON base building.

Table 2-1. CONTROL TOWER ACTIVITY LEVELS

FAA FACILITY ACTIVITY LEVEL	*FAA NUMERICAL VOLUME RANGES*
I	A facility not meeting Level II criteria.
IIa	A radar approach control facility with fewer than 100,000 annual instrument operations.
IIb	A nonradar approach control facility having a minimum of 80,000 or more total annual airport operations with 20,000 instrument operations annually; or, a minimum of 100,000 or more total airport operations with 15,000 or more instrument operations annually; or any equivalent proportionate combination within the range of these minima.
IIc	A facility having between 170,000 and 500,000 total annual airport operations.
IIIa	A radar approach control facility having between 100,000 and 300,000 annual instrument operations.
IIIb	A radar approach control facility having 100,000 or more annual instrument operations, but exercising approach control authority only in the immediate vicinity of an airport as delegated by the "parent" approach control facility.
IIIc	A facility having 500,000 or more total airport operations.
IIId	Nonradar or radar approach control facilities meeting total airport operations criterion of IIIc., but having fewer than 100,000 instrument operations annually.
IV	A radar approach control facility having 300,000 or more annual instrument operations.
V	A radar approach control facility having 100 instrument operations or more per hour for 16 hours per day on a regular basis.

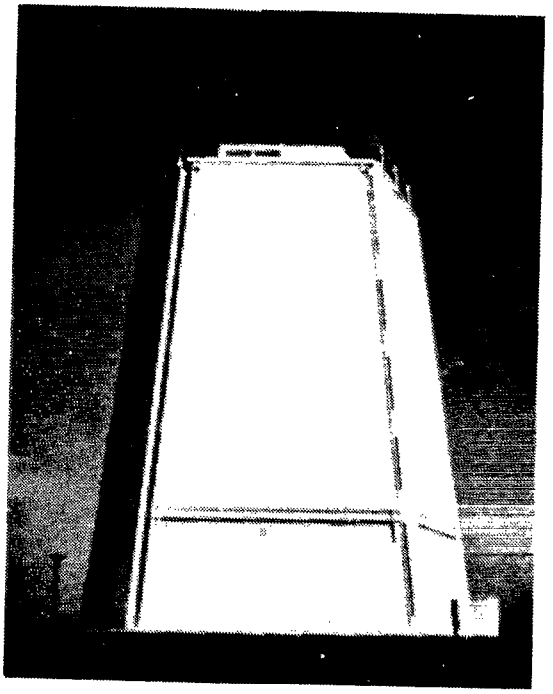


LOW ACTIVITY, TURNKEY ATCT



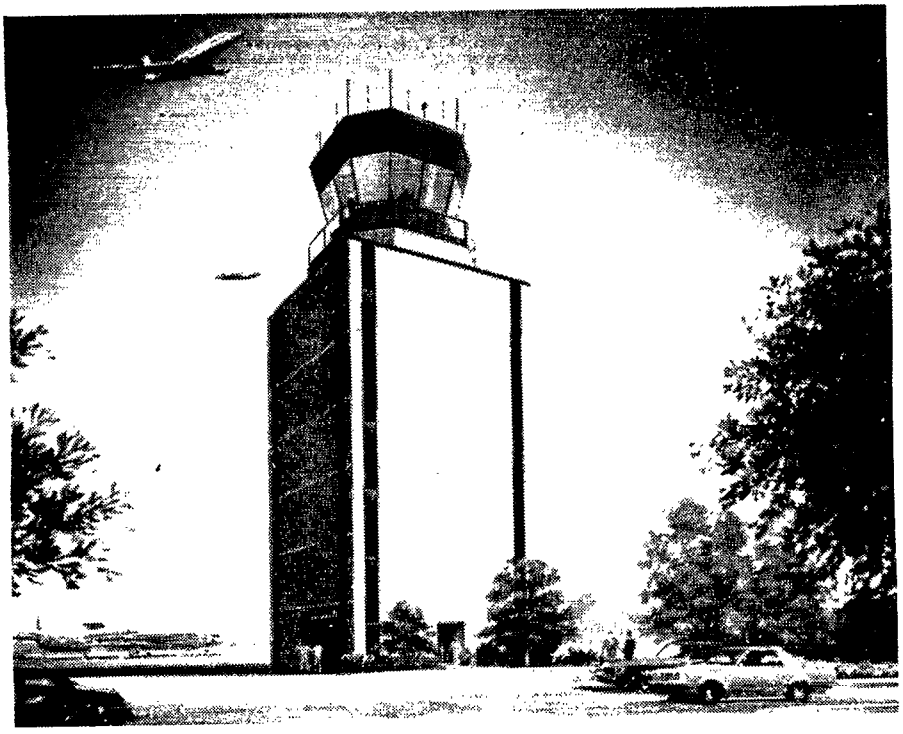
LOW ACTIVITY ATCT

LOW ACTIVITY, MOCK ATCT



INTERMEDIATE ACTIVITY, TYPE O ATCT

Figure 2-1. Freestanding Functional Shaft ATCT's

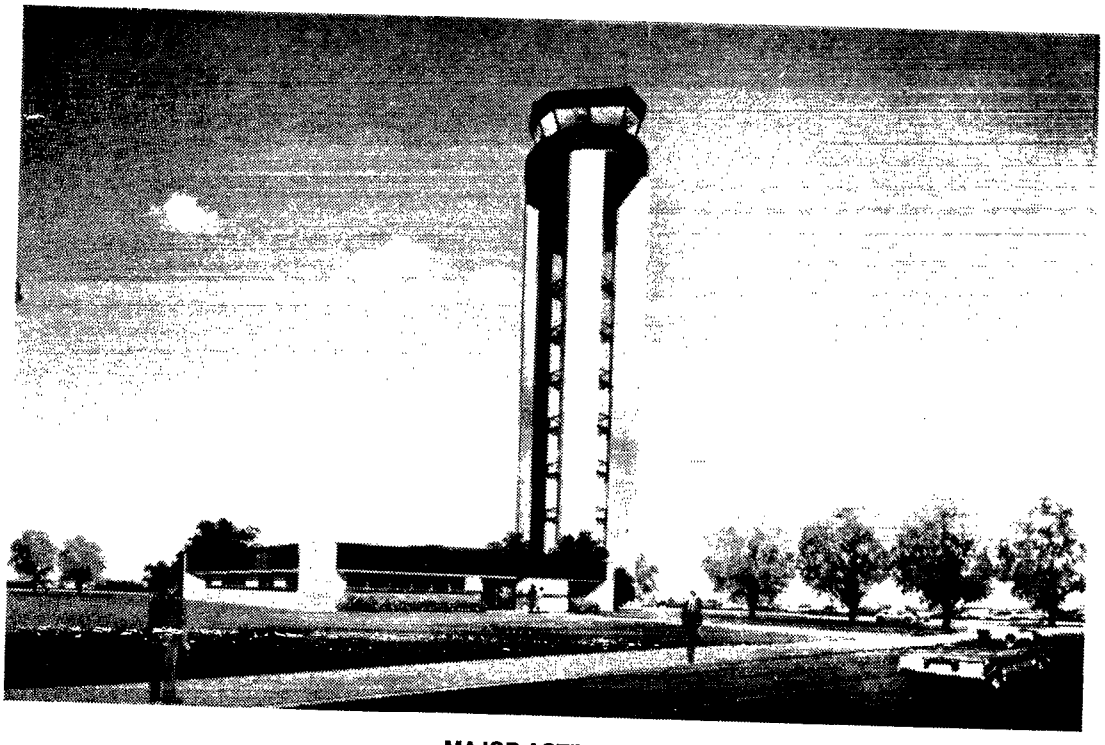


LOW ACTIVITY RADAR TOWER (LART)

Figure 2-1. Free Standing Functional Shaft ATCT's (Cont.)

Figure 2-2. Base Building And Functional Shaft ATCT

INTERMEDIATE ACTIVITY



MAJOR ACTIVITY

Figure 2-3. Base Building And Nonfunctional Shaft ATCT's

Figure 2-4. I.M. Pei Design ATCT

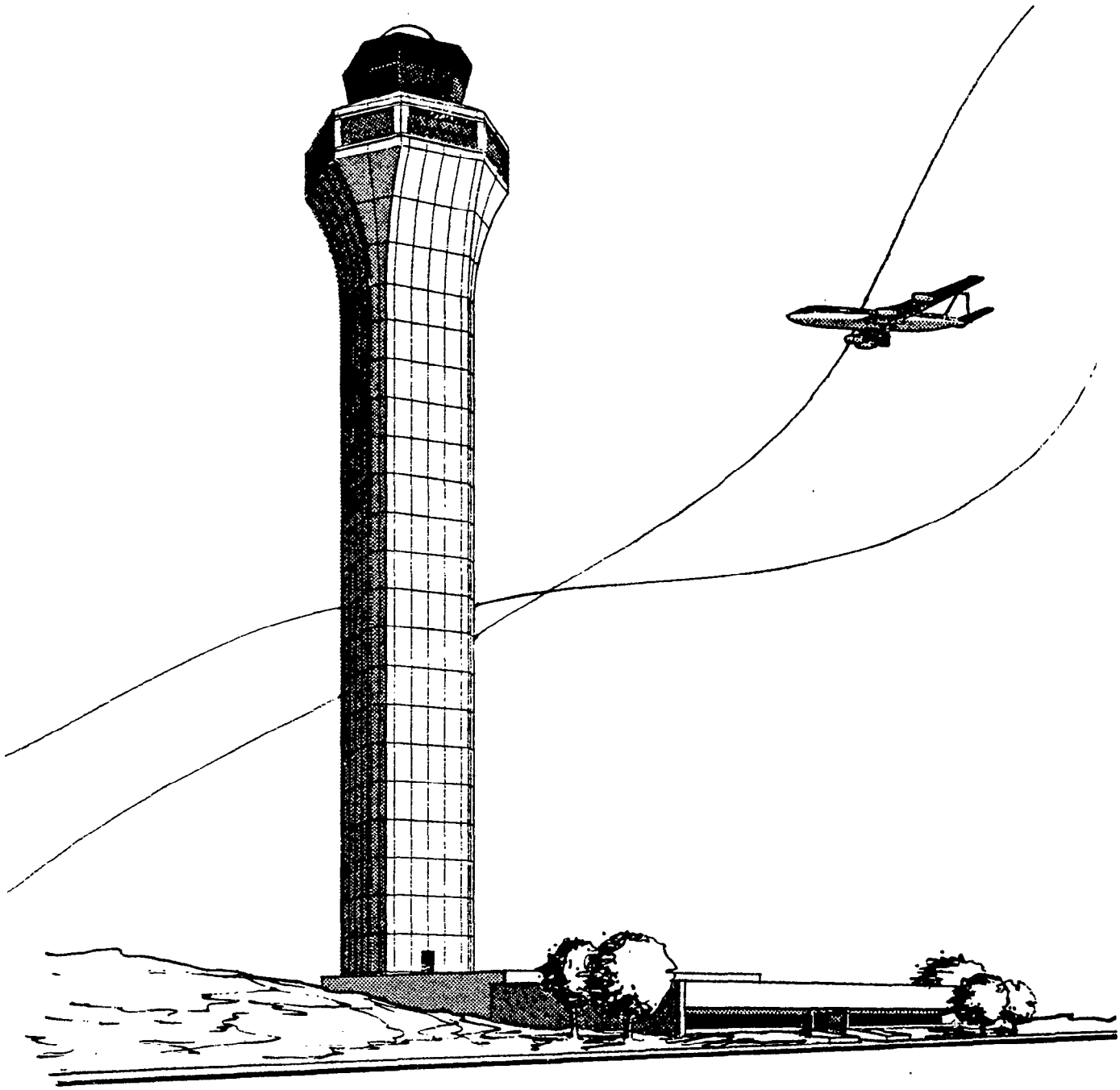


Figure 2-5. Leo A. Daly Design ATCT

24. TYPES OF TURNKEY AIRPORT TRAFFIC CONTROL TOWERS.

The turnkey ATCT's environmental systems and its subsystems are shown in figure 2-6. These facilities are modular constructed and designed for ease of extension and or relocation. Modules are stacked to form the shaft. The modules are constructed of corrugated metal paneling and framed and braced with steel support angles. The shaft supports a six-sided cab. Instruction books and the manufacturers' data should be consulted for more detailed information.

a. AIR-A-PLANE (AW-6). This low activity level facility is erected to a standard shaft height of 60 feet (18.29 meters) and has two different size module sections. The lower section is 50 feet (15.24 meters) high and constructed of five modules, each 12 feet by 12 feet by 10 feet (3.6 meters by 3.6 meters by 3.05 meters) high. The upper section is the administration module and is 24 feet by 24 feet by 10 feet (7.3 meters by 7.3 meters by 3.05 meters) high. The upper section contains an administrative office, equipment room, and a ready room. The ATCT cab is mounted on top of the administration module. Each AW-6 ATCT contains an elevator. See figure 2-7 and table 2-2.

b. AVCO and Hunt. These low activity level facilities are erected to shaft heights that range between 30 feet (9.14 meters) and 90 feet (27.3 meters). The shaft is comprised of modules 18 feet by 18 feet by 10 feet (5.49 meters by 5.49 meters by 3.05 meters) high that support the ATCT cab. Each shaft contains an administrative office, training room, and elevator shaft. Elevators are provided only in AVCO and Hunt ATCT's that have shaft heights of 50 feet (15.24 meters) or above. See figure 2-8 and table 2-2.

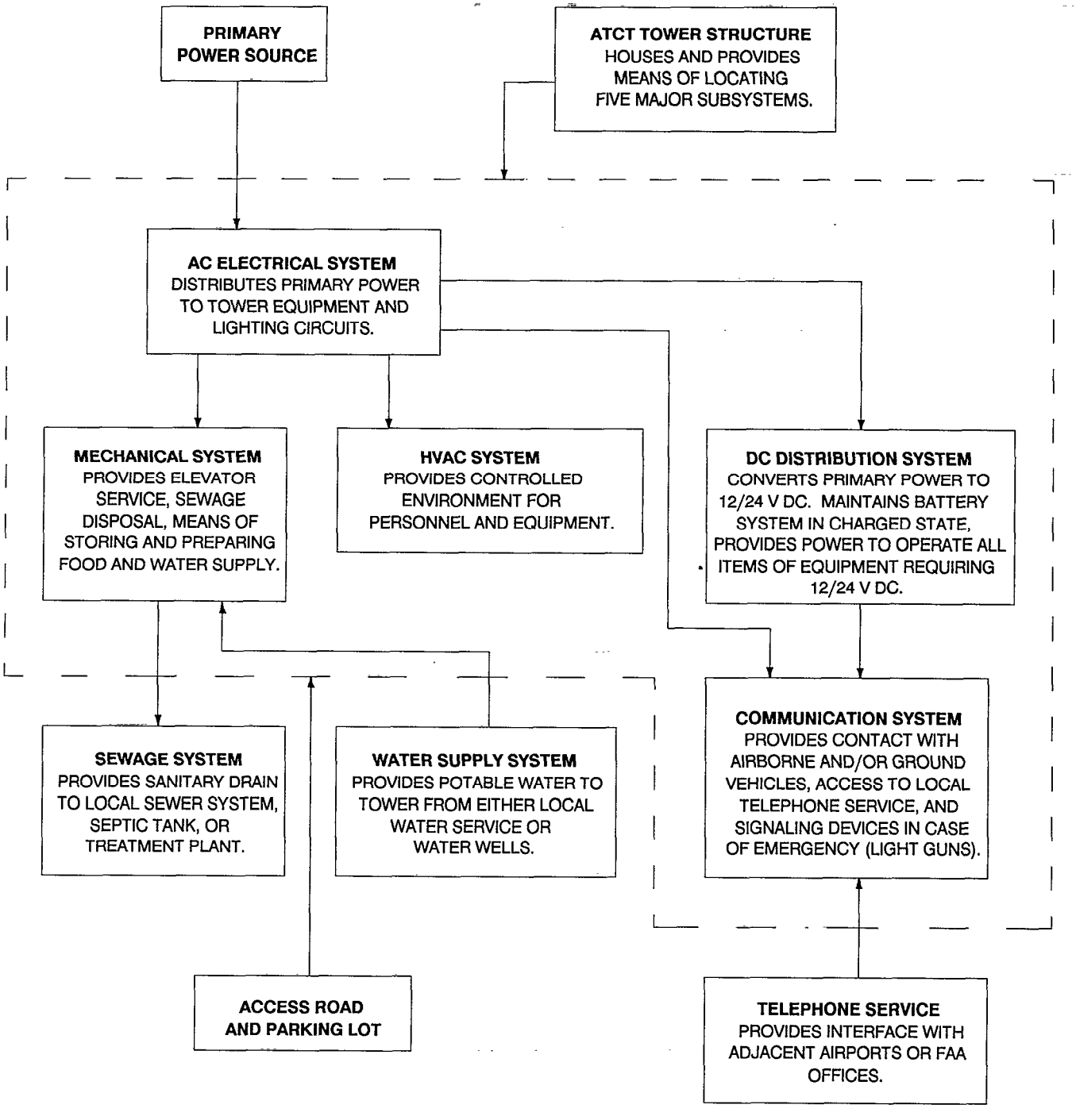


Figure 2-6. Typical Turnkey ATCT System Functional Description Diagram

Table 2-2. IDENTIFICATION OF TURNKEY ATCT'S

TYPE	*HEIGHT*	*MODULAR CONSTRUCTION*	*SHAFT SIZE*	*CAB*	*ELEVATOR*	*BASE BUILDING*
AW-6	60 ft (18.4 m)	Structural steel columns and bracing covered with metal paneling installed in 10-ft (3.05 m) -high sections	Lower section 12 ft by 12 ft by 50 ft (3.66 m by 3.66 m by 15.24 m). Upper section 24 ft by 24 ft by 10 ft (7.32 m by 7.32 m by 3.05 m)	Six-sided	All towers	Don Scott Field, Columbus, Ohio Only 40 ft by 20 ft by 10 ft (12.19 m by 6.10 m by 3.05 m)
AVCO	Height range from 30 to 90 ft (9.25 m to 27.5 m)	Structural steel columns and bracing covered with metal paneling installed in 10-ft (3.05 m) -high sections	18 ft by 18 ft (5.49 m)	Six-sided vertical panels above and below the cab	Towers with cab floor 50 ft (15.24 m) and above only)	None
Hunt	Height range from 30 to 90 ft (9.25 m to 27.5 m)	Structural steel columns and bracing covered with metal paneling installed in 10-ft (3.05 m) -high sections	18 ft by 18 ft (5.49 m)	Six-sided horizontal panels above and below the cab	Towers with cab floor 50 ft (15.24 m) and above only	None

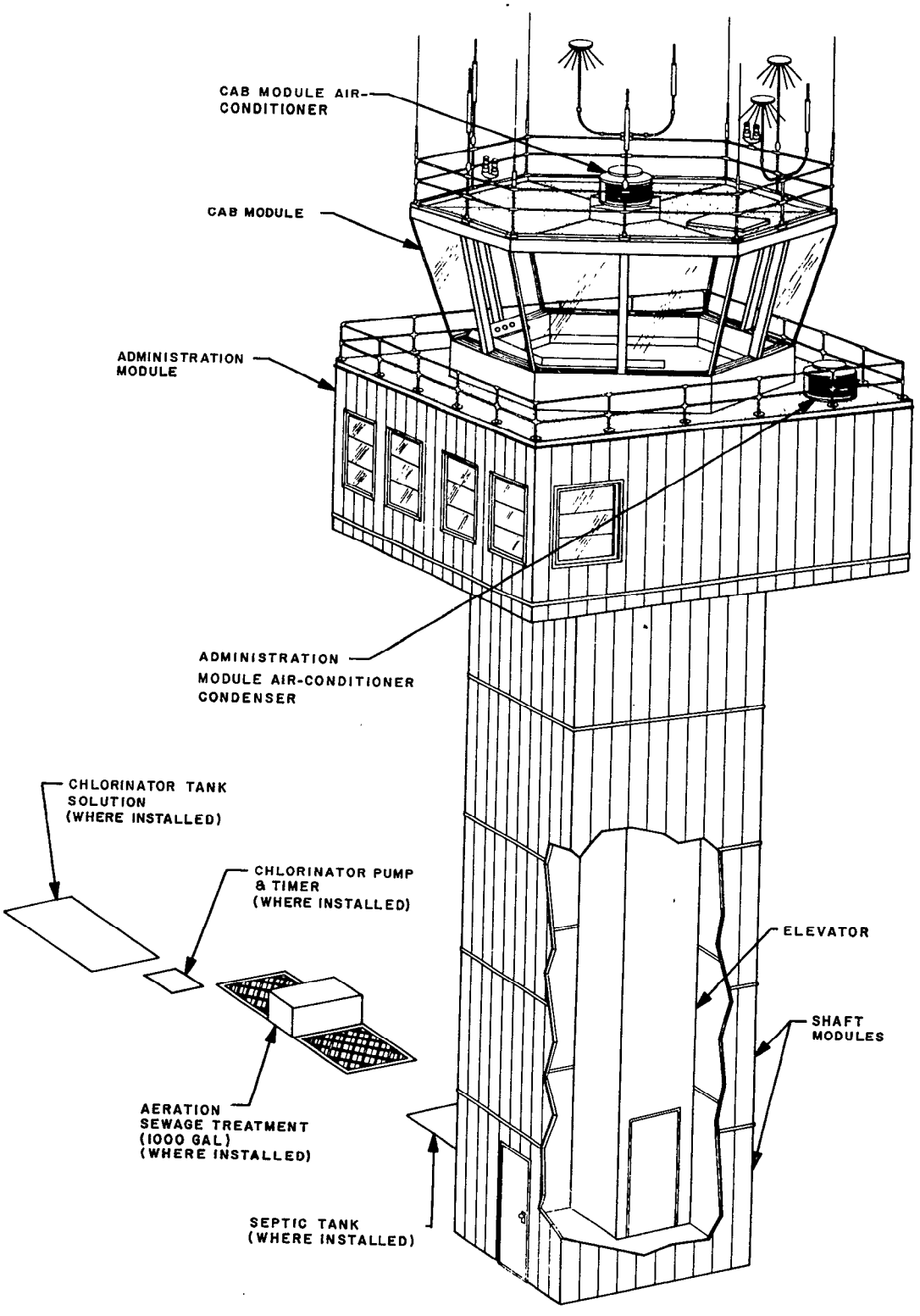


Figure 2-7. Typical AW-6 Airport Traffic Control Tower

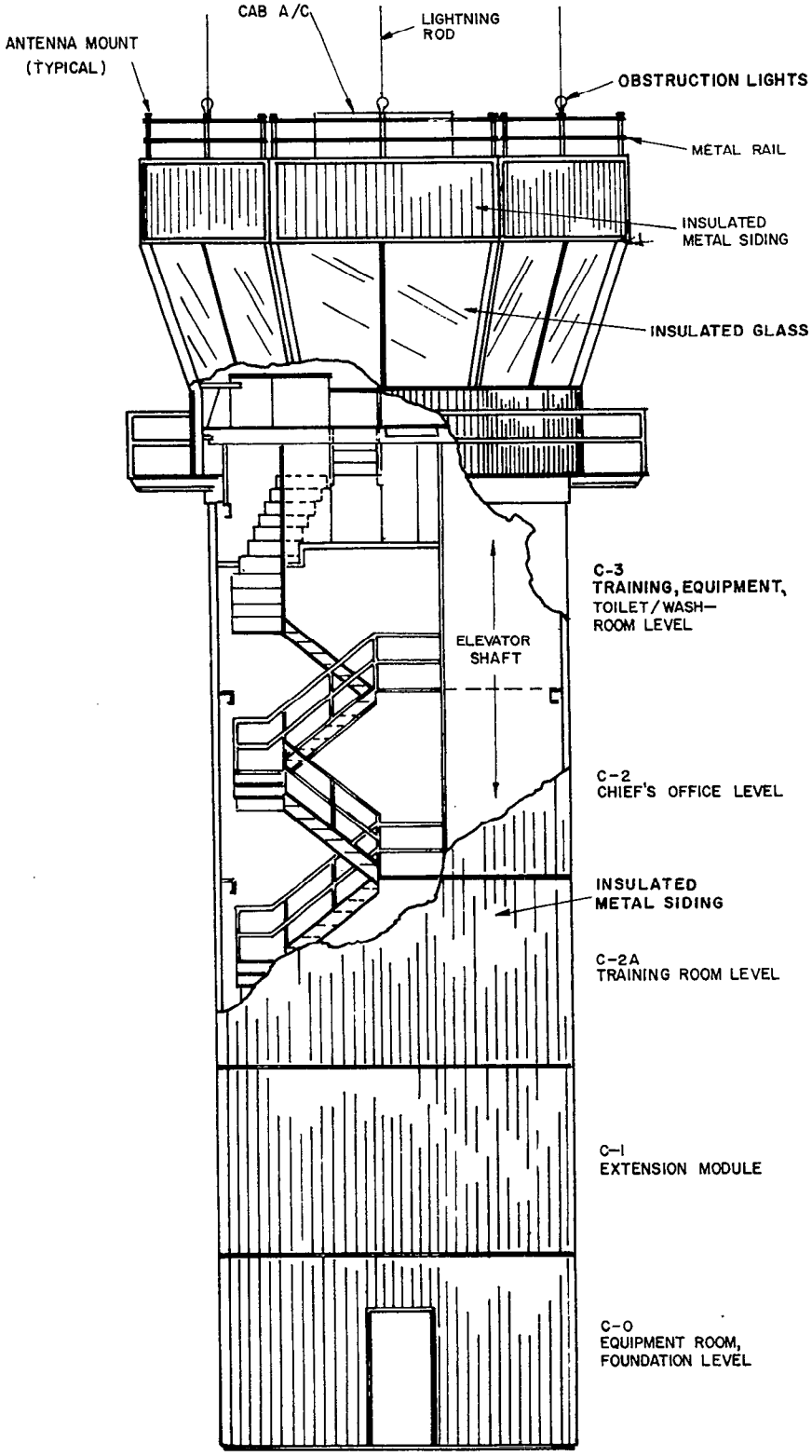


Figure 2-8. Typical AVCO or Hunt Airport Traffic Control Tower

Section 2. HEATING, VENTILATING, AND AIR-CONDITIONING SYSTEMS

25. TYPE O AND MOCK ATCT.

a. Heating. Building heat is usually provided by a hot water heating system equipped with a boiler, circulating pumps, a supply and return piping system with heating coils, and an air distribution system. Some facilities in warm climates, however, use only an air distribution system equipped with electric strip heaters in the supply ducts. The heating water system is typically a closed-loop system, which provides heating water for space temperature control. Heating water is generated by either an oil-fired, gas-fired, or electrically heated hot water boiler. Major components of the heating water system are described below.

(1) Hot Water Boiler. Some towers are equipped with an electrically heated boiler. Others are equipped with a gas or oil fired boiler unit which consists of a boiler, burner, burner controls, and draft controls in a single assembly.

(2) Heating Water Circulating Pump. A single-stage centrifugal pump is installed between the boiler supply and return to maintain water circulation through the heating system.

(3) Unit Heaters-(Type O Tower Only). Two types of automatically controlled unit heaters, each with an electric, motor-driven fan and separate thermostat, are used in the system. The entrance unit is of the blow-through type and is equipped with a belt-driven, centrifugal fan. The remaining unit heaters are of the propeller type and are equipped with direct drive motors.

(4) Convectors-(Type O Tower Only). Wall-mounted finned-tube hot water convectors, using heating water as the heat transfer medium, provide heat in certain areas not served by an air-handling system or unit heater.

b. Ventilating. Ventilation is provided by propeller or blower fans, which are either wall mounted, roof mounted, or mounted above the ceiling.

c. Air-Conditioning. Air-conditioning is usually provided by a chilled water system equipped with a reciprocating water chiller, water circulating pumps, an air-cooled condensing unit and a supply and return piping system with cooling coils. The cooling coils are located in the air distribution system as are the heating coils. An exception to the above are some facilities that use direct expansion cooling coils and, therefore have no chilled water equipment. The chilled water system is typically a closed-loop system, which provides the cooling medium for space temperature and humidity control. Chilled water is generated by an electric motor-driven, reciprocating chiller. Major components of the chilled water system are described below.

(1) Reciprocating Water Chillers. The reciprocating chiller is a factory-assembled package unit using R-22 as a refrigerant. The unit consists of a compressor and drive assembly, a refrigerant evaporator, and a condenser.

(a) The compressor is equipped with a single-speed, squirrel-cage, polyphase-motor and a forced-feed compressor lubrication system. The lubrication system includes a positive displacement pump and indicators for oil level and oil pressure.

(b) The refrigerant evaporator is a shell-and-tube heat exchanger. Headers and connections are designed for 150 pounds on both the water or refrigerant side. The evaporator provides the interface between the chilled water system and the refrigerant, while the condenser provides the interface between the refrigerant and the condenser cooling medium.

(c) Controls include all safety and operating instruments, gauges, manual override switches, and interlocks required to provide safe operation and variable output capacity to meet load conditions. Capacity controls are fully automatic with respect to stopping and restart capability.

(2) Condensing Units. Most towers are equipped with air-cooled refrigerant condensers that are located outside the building. However, some towers use an evaporative condenser located inside the building with heat rejection air ducts connected to the outside.

(3) Chilled Water Pumps. The chilled water pump is a single-stage, electric motor-driven, centrifugal unit and is used to circulate chilled water through the air-handling unit cooling coils.

d. Air Distribution System.

(1) Air Handling Units. Air handling units are constructed of galvanized sheet metal and braced with a steel angle framework. The units are ducted to control the

air distribution. The enclosures are thermally insulated. Access doors or panels are provided for servicing equipment. Each air handling unit includes a fan, which is the basic component of an air handling system. Fans are double-inlet type, with each fan in a separate scroll. Fan shafts are supported in permanently lubricated sleeve or ball bearings and are belt-driven by electric motors. The motor sheaves are adjustable to provide proper fan speed to produce the required air flow.

(2) Heating Coils. Heating coils, using heating water as the heat transfer medium, are installed in air handling units for heating the airstream.

(3) Cooling Coils. Cooling coils, using chilled water as the heat transfer medium, are installed in the air handling units for cooling and dehumidification of the airstream.

(4) Fans. Electric fans, both belt-driven and direct-drive, are installed throughout the facility for air distribution and ventilation. Fan type is either centrifugal blower or propeller. Any individual fan performs one of the following functions:

(a) Movement of conditioned air within or without ductwork.

(b) Movement of return air within ductwork.

(c) Ventilation of airspace that is not air-conditioned.

(d) Exhausting air from conditioned airspace.

(5) Filters. Filters are installed at various locations throughout the facility to filter intake and return air. Air handling units have filters installed within the ductwork. Wall-mounted or roof-mounted air intake filters are used in areas where fans are installed for ventilation. The type of filter varies with the specific system, area, or unit involved. In general, they are replaceable-media type, replaceable-cartridge type, or renewable-roll type, depending upon the application.

e. Instrument Air System. The instrument air system consists of a reciprocating compressor complete with air filter and air dryer. The compressor is an automatically controlled, single-stage unit driven with an electric motor.

26. PEI ATCT.

a. Heating. Most Pei ATCT's use a hot-water heating system equipped with a boiler, converter, circulating pumps, and heating coils installed in the air-handling units. However, some facilities use electric duct heaters for primary heat instead of using the water heating system. All facilities use electric unit (space) heaters for heating areas not normally occupied by personnel. The humidity is controlled during the heating season by injecting steam into the air handling units. Typical heating system components are:

(1) Steam Boiler. The steam boiler is a horizontal multipass fire tube, Scotch Marine type, with a centrally located furnace. The furnace has a forced draft burner that uses natural gas or No. 2 fuel oil. On combination burners, a fuel selector switch is provided to switch from one fuel to the other. All fireside and waterside safety devices, ignition system, etc., are provided with the boiler. The boiler is designed for 15 psig (103 kilonewtons per square meter (kN/m^2)) steam working pressure. The rating depends on the climatic zone in which the facility is located. Not all facilities have boilers; some facilities obtain heat to the converter from a non-FAA-owned plant.

(2) Steam Converters. The converter is used to heat the main hot water supply, which is circulated to the air-handling units. The converter is normally rated for 15 psig (103 kN/m^2) steam-side working pressure and 125 psig (760 kN/m^2) waterside working pressure.

(3) Condensate Return Unit. The condensate return unit is a duplex type with two centrifugal pumps specifically designed for pumping hot water. The unit is equipped with an automatic alternator switch to provide alternate or combined operation of the two pumps as required.

(4) Electric Duct Heaters. The duct heaters consist of coils of resistance wire formed into, and supported in, a grid that is installed in the air distribution duct. Duct heaters are normally assembled in units of 5 kilowatts or less. When more heat is required, additional assemblies are paralleled within the air duct.

(5) Electric Unit Heaters. Electric unit heaters with propeller fans are used to heat the tower shaft stairway, machine room, and lavatory.

b. Ventilation. There are ventilation fans or exhaust fans for the electronic equipment room, terminal radar approach control (TRACON) room (radar base), engine-generator room, toilets, and cab.

(1) The exhaust fans for the toilets are controlled with manual switches and are on the emergency power circuit.

(2) The intake louvers of the engine-generator (E/G) room are interlocked with the discharge air of the E/G radiator. Upon a rise in discharge air temperature, the intake air and bypass louvers modulate open and the discharge louvers modulate closed. On a drop in discharge air temperature, the intake, bypass, and discharge louvers are modulated in the reverse direction. The radiator fan acts as the E/G room ventilation fan when the engine generator is operating.

(3) The exhaust fans in the TRACON room, electronic equipment room, and tower cab provide emergency ventilation if the air-conditioning system fails. Since these fans and the air-handling units are connected to the essential distribution panel, they can be operated when commercial or prime power is lost. In an emergency, the exhaust fans may be started manually and the air-handling units switched to provide 100-percent outside air.

c. Air-Conditioning. Building cooling is normally accomplished by use of a direct-expansion central-type air-conditioner system. Some facilities are cooled by chilled water systems, which may be from a non-FAA-owned plant. Major components of the air-conditioning systems are:

(1) Direct-Expansion System. This system consists of an evaporator coil located in the air- handling unit and a condensing unit located outside the building. Sometimes package air-conditioning units are used at the junction level of the tower. The package units may use water-cooled or air-cooled condensers.

(2) Chilled-Water system. The chilled-water system is typically a closed-loop system. The chilled-water cooling source can be a reciprocating or centrifugal chiller or may be from a non-FAA-owned source.

d. Air-Handling Units. At most Pei ATCT's, there are two air-handling units, designated units No. 1 and No. 2. Unit No. 1 is a single-zone unit, and unit No. 2 is a multi-zone unit. Larger facilities have additional units.

(1) Unit No. 1. This unit is a draw-through type that serves the tower cab. The unit contains a centrifugal blower, motor, two-circuit direct-expansion cooling coil and hot-water heating coil, steam humidifier, non-freeze steam preheat coil and face, and bypass dampers.

(2) Unit No. 2. This unit serves the base building. It has zones for the radar base and zones for the nonradar base. This air handler has a multizone fan and coil unit of the blow-through type with a centrifugal blower, motor, two-circuit direct-expansion cooling coil and hot water heating coil, steam humidifier, nonfreeze steam preheat coil, and zone mixing dampers.

(3) Coils. The cooling and heating coils of units No. 1 and No. 2 are copper with aluminum fins. They are rated 200 psig (1380 kN/m^2) working pressure for water or steam coils and 300 psig (2068 kN/m^2) working pressure for refrigerant coils.

e. Instrument Air System. The instrument air system consists of an air compressor and tank, air dryer, valves, and various pneumatic controllers and controlled devices.

(1) Compressor and Tank. The motor-driven compressor is sized for full system operation when running not more than 33 1/3 percent of the time. The tank is sized for not less than a 10-minute off cycle with less than a 10 pounds per square inch (psi) (69 kN/m^2) drop in tank pressure.

(2) Drier. The drier is a mechanical, refrigerated, air-cooled type. The drier is installed and valved for isolation of the drier for repairs and service, without interrupting operation of the pneumatic control system.

27. HUNT, AVCO, AND AW-6 (TURNKEY) ATCT.

a. Heating and Air-Conditioning System.

(1) The cab air-conditioning system is roof mounted with airflow through ceiling ducts discharging inside the cab. Operation of the cab air-conditioner is controlled by a thermostat. The same ducts and blowers are used for cooling and heating. Heat is provided by heating elements installed in the ducts and also is controlled by a thermostat.

(2) Administrative, Training, and Equipment Areas.

(a) AW-6. These areas are heated and cooled with separate units identical to the cab area system.

(b) AVCO and Hunt. Heating and cooling is provided by through-the-wall heating and cooling combination units. The units contain a heat section and cooling chassis that function by thermostat control.

(3) Other Areas. Only heat is supplied to all other areas in turnkey ATCT's. Electric heaters are either wall mounted or ceiling suspended, and cycle on and off as a function of a thermostat.

b. Ventilating System. Ventilated air is provided by a system consisting of exhaust fans, dampers, plenum louvers, and vents. These units may be either wall or ceiling mounted. The system ventilates space that is not air-conditioned and exhausts air from air-conditioned areas.

28. WELTON BECKET ATCT.

a. Heating. Various methods are used to heat Welton Becket ATCT facilities. Some towers receive their heat from electric heaters located in the air-handling units. Others are equipped with a system that circulates heating water through coils located in the air-handling units. The heating water circulated by centrifugal pumps received its heat from a steam-to-hot water converter. The converter is supplied with steam from a facility boiler or in some cases, a steam-generating plant not owned or operated by FAA. Electric unit heaters with propeller fans are used to heat the tower shaft stairway, machine room, and lavatory.

b. Air-Conditioning. Welton Becket towers are equipped with a cooling system that circulates chilled water through cooling coils located in the air-handling units. This chilled water is supplied from Freon (direct expansion) water chillers in most cases. At some towers, however, the chilled water is supplied from a central plant not owned or operated by FAA.

c. Air-Handling Units. Welton Becket towers are equipped with both single zone and multizoned air-handling units. These units include a blower, a heating coil (either hot water or electric), a cooling coil, control dampers, and in some cases preheat coils, reheat coils, and humidifiers.

d. Ventilation.

(1) Tower and Base Building. Welton Becket towers are equipped with exhaust fans for the electronic equipment areas, the terminal radar approach control (TRACON) area, the engine generator room, the toilets, and tower cab. The exhaust fans in the TRACON room, electronic equipment room, and tower cab provide emergency ventilation if the air-conditioning system fails. These fans and their associated air-handling units are connected to the standby power system; therefore, they can be operated when commercial power is lost. In an emergency, the exhaust fans may be started manually and the air-handling units switched to operate with 100-percent outside air. The exhaust fans for the toilets are controlled with manual switches and are, also, connected to standby power.

(2) Engine Generator Room. The intake louvers of the engine generator (E/G) room are interlocked with the discharge air of the E/G radiator. Upon a rise in discharge air temperature, the intake air and bypass louvers modulate open and the discharge louvers modulate closed. On a drop in discharge air temperature, the intake, bypass, and discharge louvers are modulated in the reverse direction. The engine radiator fan ventilates the E/G room when the engine generator is operating.

e. Instrument Air System. The instrument air system consists of an air compressor and tank, air drier, valves, and various pneumatic controllers and controlled devices.

(1) Compressor and Tank. The motor-driven compressor is sized for full system operation when running not more than 33 1/3 percent of the time. The tank is sized for not less than a 10-minute off cycle with less than a 10 psi (69 kN/m^2) drop in tank pressure.

(2) Drier. The drier is a mechanical, refrigerated, air cooled type. The drier is installed and valved for isolation of the drier for repair and service, without interrupting operation of the pneumatic control system.

29. GOLEMON ROLFE ATCT.

a. Base Building HVAC System. Golemon Rolfe ATCT facilities usually are equipped with a dual duct air-distribution system, consisting of a separate cold duct for cooled air and a separate hot duct for heated air. The hot air and cold air are mixed at their point of use in a mixing box which blends the air in response to a room thermostat. These mixing boxes not only control the temperatures of the air entering the room but also in some cases the air volume. The cold air is obtained from direct-expansion air-conditioning units. The hot air is obtained at some sites from a solar heating system supplemented by electric or natural gas heat. Other sites have no solar heating system and are heated totally by electric-resistance duct heaters.

b. Solar Heating System.

(1) General. The solar heating system consists of a solar wall that absorbs heat from the sun, a solar storage chamber where the heat is stored, and a circulating air stream (solar loop) that transfers the heat from the solar wall to the storage chamber. Heated air is extracted from the storage chamber and supplied to the base building by the hot duct air-handling unit.

(2) Solar Wall. The solar wall consists of a series of air baffles mounted in the south wall of the base building behind a glass panel. this baffled air space absorbs heat from the sun and then acts as a heat source for the solar loop air stream.

(3) Solar Storage Chamber. The storage chamber consists of a room containing vertical fiberglass tubes filled with water. These tubes act to absorb and store heat received from the solar loop.

(4) Solar Loop. The solar loop is a stream of air that is circulated through the solar wall, through the solar chamber, and back to the solar wall. The purpose of the loop is to supply heated air to the storage chamber. The air is circulated by means of a centrifugal blower controlled by a temperature sensor located in the solar wall air stream. Air is circulated throughout the loop when it is available from the solar wall and as it is required for building heat.

c. Tower HVAC System. The tower entry level is heated and cooled by a duct extension from the base building HVAC system. The tower cab is heated and cooled by dual heat pumps. The cab heat pumps are identical and are each sized to handle 50 percent of the load. The subjunction level of the smaller towers is served from the tower cab heat pumps. Larger towers have a separate heat pump that serves the subjunction level. All tower heat pumps have electric resistance heating coils for supplementing their heat.

d. Heat Pump Operation. The heat pump system moves, or pumps, heat in either direction, depending on whether heating or cooling is required. the heat pump takes advantage of the fact that even when the outside temperature is below freezing, the air contains heat that can be recovered for indoor use during winter months. During the summer, the system is reversed and heat is taken from the inside and is pumped to the outside. This is accomplished by an arrangement of refrigerant valves that permits the function of the evaporator and condenser to be interchanged, thus reversing the heating-cooling process.

e. Ventilation.

(1) Tower and Base Building. Golemon Rolfe towers are equipped with exhaust fans for the electronic equipment areas, the terminal radar approach control (TRACON) area, the engine generator room, the toilets, and tower cab. The exhaust fans in the TRACON room, electronic equipment room, and tower cab provide emergency ventilation if the air-conditioning system fails. These fans and their associated air-handling units are connected to the standby power system, therefore, they can be operated when commercial power is lost. In an emergency, the exhaust fans may be started manually and the air-handling units switched to operate with 100 percent outside air. The exhaust fans for the toilets are controlled with manual switches and are, also, connected to standby power.

(2) Engine Generator Room. The intake louvers of the engine generator (E/G) room are interlocked with the discharge air of the E/G exhaust fan. Upon a rise in discharge air temperature, the intake air louvers modulate open. On a drop in discharge air temperature, the intake louvers are modulated in the reverse direction. The E/G exhaust fan ventilates the E/G room when the engine generator is operating and when the room temperature is above the thermostat set point.

b. Instrument Air System. The instrument air system consists of an air compressor, receiver, air drier, valves, and various pneumatic controllers and controlled devices.

(1) Compressor and Tank. The motor-driven compressor is sized for full system operation when running not more than one third of the time. The tank is sized for not less than a 10 minute off cycle with less than a 10 psi drop in tank pressure.

(2) Drier. The drier is a mechanical, refrigerated, air cooled type. The drier is installed and valved for isolation of the drier for repair and service, without interrupting operation of the pneumatic control system.

30.-49. RESERVED.

Section 3. ELECTRICAL SYSTEMS

50. ELECTRICAL SERVICE.

ATCT facilities are normally provided with power from a commercial source supplied through a main distribution transformer. The secondary side of the main distribution transformer usually terminates in a separate fused service disconnect switch or a main breaker in the main distribution panel. The main distribution panel feeds power to both the essential and the nonessential distribution panels. The essential distribution panel supplies power to the essential load located throughout the facility. The nonessential distribution panel supplies power to the nonessential load throughout the facility. The distribution panels are usually equipped with bolt-on type circuit breakers. The power supplied may be 120/208 or 277/480 volts, 60-Hz, three-phase, four-wire as required by the system design. Figure 2-9 is a typical electrical service diagram of an AW-6 (turnkey) tower.

51. POWER AND LIGHTING DISTRIBUTION.

a. General. Essential power is distributed throughout the facility from the essential distribution panel. Nonessential power is distributed in a similar manner from the nonessential distribution panel. Figure 2-10 illustrates a typical AVCO or Hunt (turnkey) tower distribution system.

b. Essential Distribution Panels. Essential panels for electronic equipment are normally rated 120/208 volts, 60-Hz, three-phase, four-wire. A separate panel serving only electronic equipment is normally provided in the following areas.

(1) Cab

(2) Communication equipment room

(3) Radar/Automated Radar Terminal System (ARTS) equipment room

(4) TRACON room

(5) Telephone equipment room

(6) Communications and radar workshop

(7) ASDE equipment

(8) RML/TML equipment

(9) PCS/UPS equipment

c. Nonessential Distribution Panels. Distribution panels for nonessential (building) loads normally are rated 277/480 or 120/208 volts, 60-Hz, three-phase, four-wire, as required by the building service. The building loads normally consist of the following.

(1) Motors 3/4 horse power (hp) and larger: 480 volts, three-phase (if available from building service) or 208 volts, three-phase.

(2) Motors 1/2 hp and less: 120 volts, single-phase.

(3) Fluorescent lighting: 277 volts (if available) or 120 volts.

(4) Mercury lighting: 277 or 480 volts (if available) or 120 volts.

(5) Incandescent lighting and convenience outlets: 120 volts.

52. STANDBY POWER SYSTEM.

A standby power system is provided in accordance with Order 6480.7B, Airport Traffic Control Tower and Terminal Radar Approach Control Facility Design. Under normal operating conditions, all facility electrical loads are served from the commercial source. If commercial power fails or becomes out of tolerance in supply characteristic, the system operates automatically to transfer the essential facility loads to the standby power system. The standby power system usually consists of a standby engine generator with an automatic transfer switch. A bypass switch is incorporated as auxiliary equipment which allows the isolation of the engine generator for maintenance, without interrupting power to the facility. A power conditioning system (PCS) is installed at some facilities to supply power to critical equipment. The following equipment is connected to the essential power distribution system.

a. Panelboards serving FAA electronic equipment.

b. Panelboards required for emergency lighting.

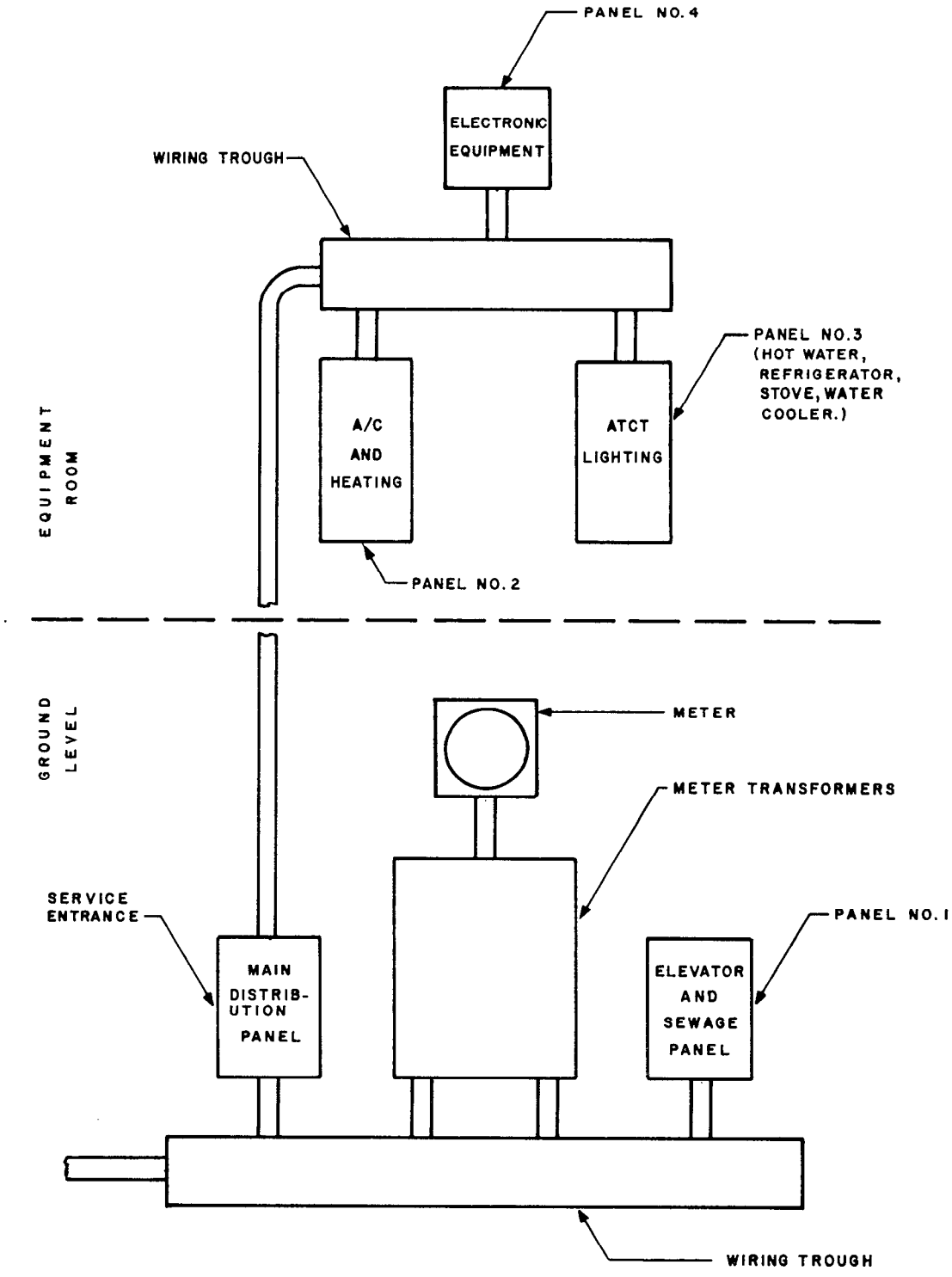


Figure 2-9. Typical AW-6 Electrical Service Diagram

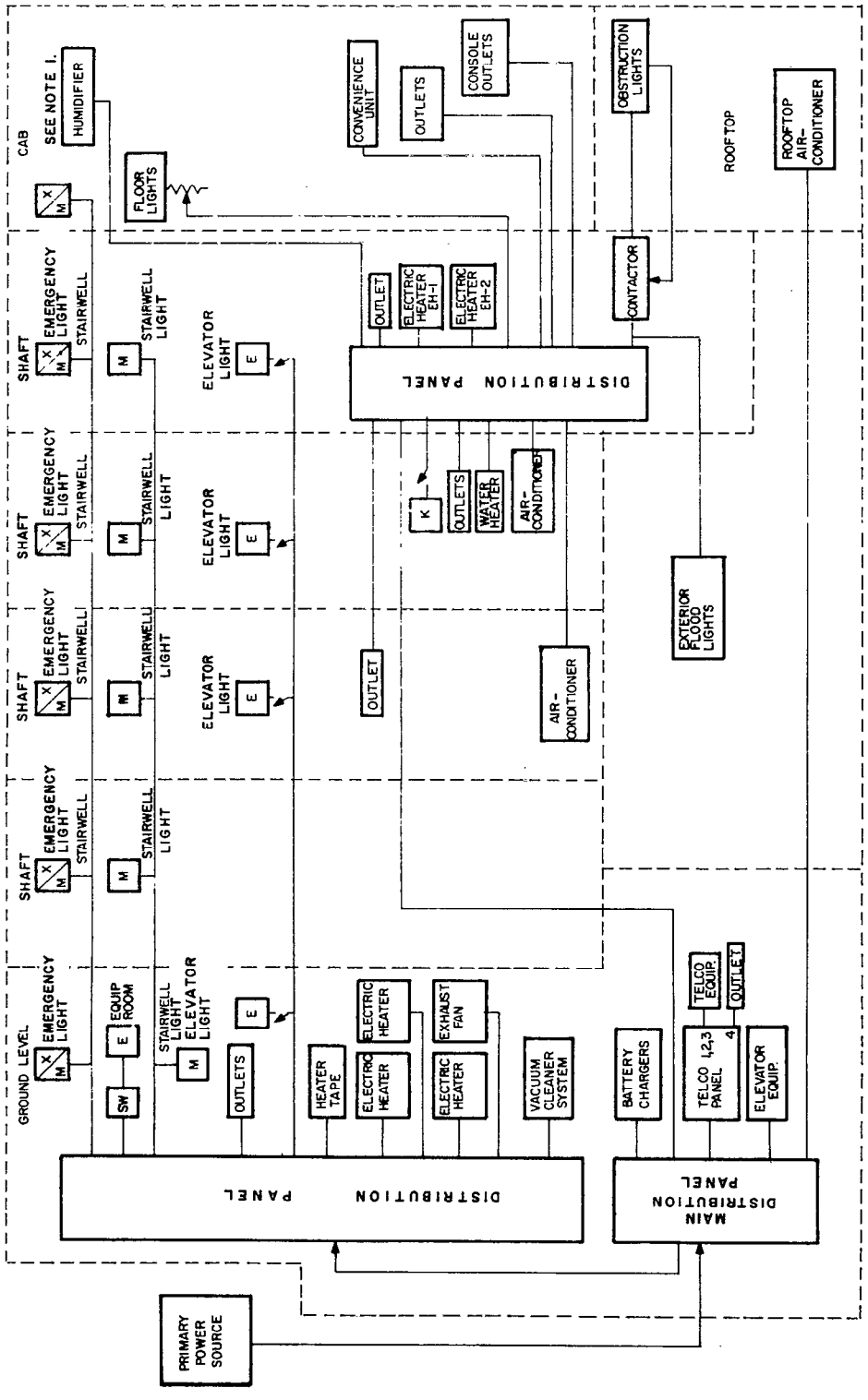


Figure 2-10. Typical AVCO and Hunt Alternating Current Power Distribution System

c. Mechanical equipment serving the electronic equipment room, cab, TRACON, radar or automated radar terminal system (ARTS) room, and telephone company (telco) room.

d. A ground level manual transfer switch serving the control tower elevator.

e. Smoke detection system.

53. ENGINE GENERATOR.

The engine generator is usually government-furnished and includes the muffler, radiator, and day tank. All fuel, water, and exhaust piping are included. The fuel storage tank is located to permit easy access for filling. The storage tank is either steel or fiberglass and is usually sized to allow for not less than 72 hours of continuous engine operation.

54. CAB DC POWER SYSTEM.

a. In addition to an engine generator, some towers may have a dc system to provide backup power to critical cab communication equipment. This nominal 12- or 24-volt dc system consists of the following items.

(1) Dc electrical panel.

(2) Batteries capable of sustaining operation of the equipment for 4 hours after loss of commercial power.

(3) Rectifier with sufficient capacity to supply dc power to the system and recharge the batteries within 12 hours following a 4-hour operation of the batteries.

b. Figure 2-11 illustrates a typical AVCO, Hunt, or AW-6 (turnkey) tower dc power distribution system that supplies power to the ATCT equipment if the primary power fails. In the AW-6 ATCT's only 12 volts dc is available from built-in transceiver battery packs. The AVCO and Hunt ATCT's both have 12 V dc and 24 V dc distribution systems.

55. GROUNDING PROTECTION.

Grounding protection for Hunt, AVCO, and AW-6 (turnkey) towers is provided by No. 6 AWG copper wire attached to ground rods below grade outside the base of the tower. The ground wire is routed via the cable chase to the cab. At each module level the ground wire is available for routing to the equipment as necessary. Grounding protection shall be installed in accordance with Order 6950.19, Practices and Procedures for Lightning Protection, Grounding, Bonding, and Shielding Implementation, and Order 6950.20, Fundamental Considerations of Lightning Protection, Grounding, Bonding and Shielding.

56. LIGHTNING PROTECTION.

Lightning protection for Hunt, AVCO, and AW-6 (turnkey) towers is provided by 3/4-inch-diameter copper clad steel air terminals (lightning rods) installed on the ATCT roof. A stranded gauge copper wire is attached and routed via ATCT column to ground rods below grade outside the ATCT base. Lightning protection shall be installed in accordance with Order 6950.19. Practices and Procedures for Lightning Protection, Grounding, Bonding, and Shielding Implementation and Order 6950.20, Fundamental Considerations of Lightning Protection, Grounding Bonding and Shielding.

57. EMERGENCY LIGHTING.

a. **Low Activity Towers.** Low activity towers are provided with battery-type emergency lights in the following areas.

(1) Exits, corridors, and stairs.

(2) Areas containing critical electrical, electronic, and mechanical equipment.

b. **High Activity Towers.** High activity towers are provided with the following emergency lightning equipment.

(1) Battery-type lights used in stairwells and in critical electrical and mechanical rooms.

(2) In other areas, a sufficient number of the general building luminaries connected to the emergency power system to provide illumination for emergency exiting.

58.-79. RESERVED.

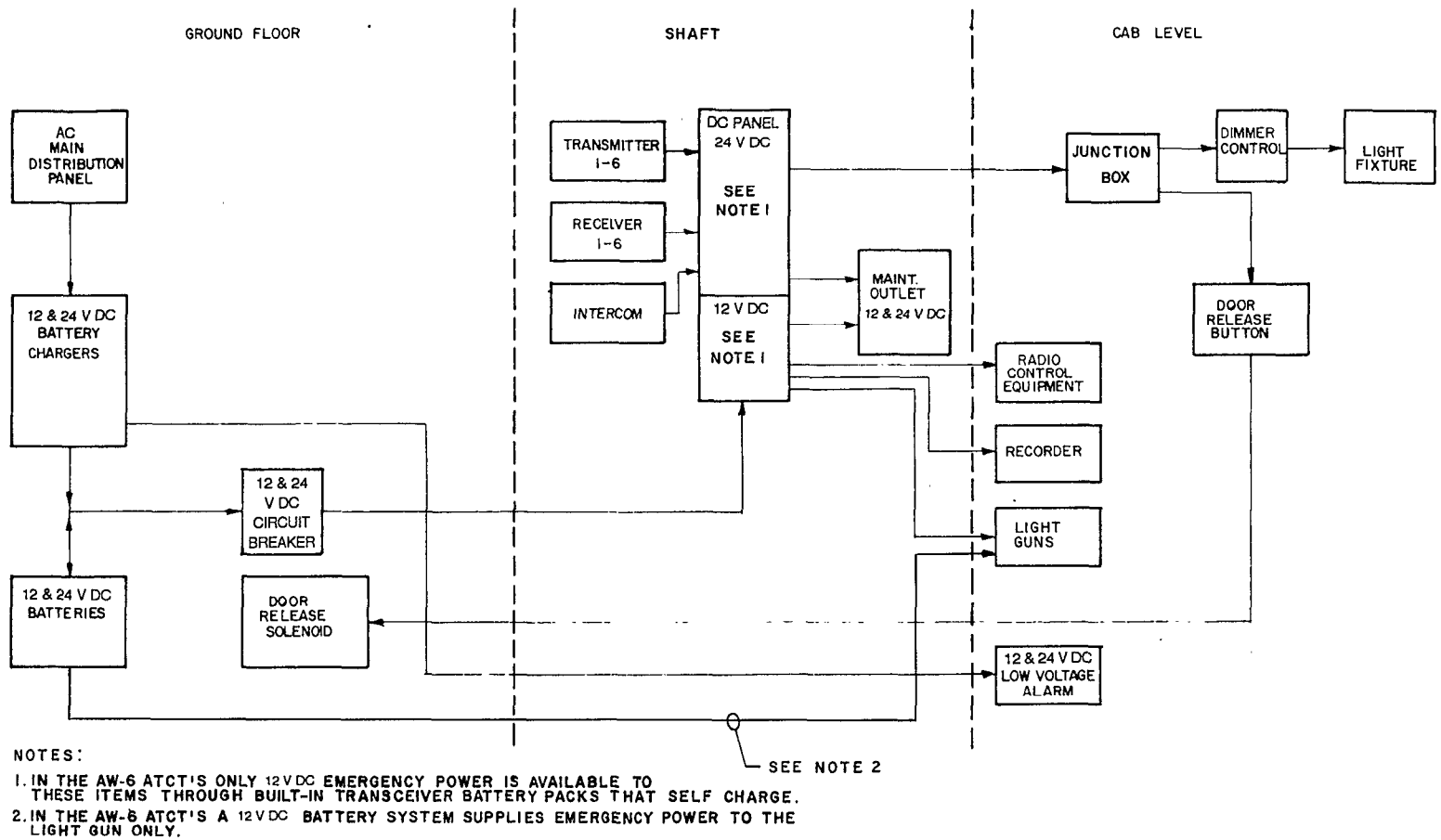


Figure 2-11. Typical Direct Current Power Distribution System

Section 4. BUILDING SYSTEMS

80.-89. RESERVED.

Section 5. MISCELLANEOUS SYSTEMS

90. INTERCOM SYSTEM.

An intercom system is provided between the tower cab, administrative offices, and the tower entrance at most facilities. Additional intercom stations are provided at the larger facilities.

91. ELEVATORS.

Elevators are installed in some ATCT facilities to provide personnel and freight lift from the ground level to the subjunction level below the control cab. Elevators are usually installed in towers where the cab floor elevation is 50 feet (15 meters) or more above the ground floor elevation.

92. FIRE EXTINGUISHERS.

Fire extinguishers are selected for ATCT facilities in accordance with the latest edition of FAA-STD-004a, Criteria for Selection and Installation of Fire Extinguishers. These fire extinguishers are maintained in accordance with Order 6930.1A, Fire Prevention and Maintenance of Fire Protection Equipment.

93. FIRE PARTITIONS.

Fire partitions are installed in ATCT buildings to separate areas of hazardous occupancies from areas of ordinary or light-hazard occupancy. Hazardous areas are categorized as mechanical, generator, elevator, and battery rooms and technical equipment rooms such as communications, radar, telephone, and TRACON. Light-hazard areas are stairways, corridors, offices, training rooms, ready rooms, and the control cab. Fire partitions are constructed to have a fire resistance rating of 1 hour with the exception of required exit stairways, mechanical rooms, and engine-generator rooms, which shall have a fire resistance rating of 2 hours.

94. FIRE ALARM SYSTEM.

Fire alarm systems are installed in some ATCT facilities. The fire alarm system when installed consists of ionization smoke detectors, manual alarm stations, and a control panel. The ionization smoke detectors are located in the mechanical and electrical rooms, electronic equipment rooms, storage rooms, and any other areas considered a probable source of fire. Manual alarm stations may be provided in the cab, shaft, and any base buildings. The control panel is located in the cab or TRACON room, when applicable. The control panel will annunciate an alarm with activation of any alarm station or detector and is capable of shutting down air-handling by zones. The control panel may be tied to leased telephone lines for annunciation of any alarm to the local fire department. The Halon extinguisher system (if installed) is activated by the smoke detectors through the control panel.

95. WATER PRESSURE.

A water pressure booster pump is installed at ATCT locations where the main water service pressure is below 30 psig (207 kilonewtons per square meter).

96. FIXTURES AND VALVES.

a. Control Cab. The control cab at ATCT facilities has a compact refrigerator, sink with drinking fountain, and water cooler.

b. Break Room. ATCT facilities with break rooms usually have a compact refrigerator, sink, and two-burner range.

c. Service Areas. All service areas have floor-type service sinks with wall faucet bracket and faucet hose connection.

d. Building Perimeter. Hose-bibs are provided at ground level around the perimeter of the building and at the cab walkway level. All exterior hose-bibs subject to freezing are freeze-proof type.

97. SANITARY TREATMENT.

ATCT facilities are connected to a local sanitary system, if available. When such a connection is not possible, the facility will include a storage or a sanitary treatment system. Maintenance of sanitary treatment systems is established in Order 6920.2A, Maintenance of Water and Sanitation Systems.

98. FLOOR HATCH AND HOIST.

ATCT facilities are usually equipped with a hatch in the cab floor and an electric hoist or an eyebolt centered above the hatch. This hatch provides a means to move equipment in and out of the cab area.

99. WINDOW-WASHING SYSTEM.

Automatic pneumatic window washers are installed on some ATCT cabs. Other ATCT's have a catwalk to allow washing of windows by maintenance personnel.

100. VACUUM CLEANING SYSTEM.

A central vacuum system is installed in some ATCT facilities. These systems consist of a remotely located blower unit complete with permanently installed dust collection piping. Blower units are located remote from both areas because of the noise they produce.

101. SIGNAL LIGHT GUNS.

Signal light guns are used to visually signal aircraft near an airport and to control aircraft and vehicles at the airport when radio communications are not available. The signal light has a pistol-grip handle and aiming sights. It is normally suspended from the ceiling of the control tower by a retractable, spring-loaded cable reel. Signal lights have a clear light beam and red and green filters.

102.-119. RESERVED.

CHAPTER 3. STANDARDS AND TOLERANCES

120. GENERAL.

a. This chapter prescribes the standards and tolerances for airport traffic control tower facilities as defined and described in Order 6000.15B, General Maintenance Handbook for Airway Facilities.

b. References to handbooks include:

(1) Order 6560.13B, Maintenance of Aviation Meteorological Systems and Miscellaneous Aids.

(2) Order 6850.5B, Maintenance of Lighted Navigational Aids.

(3) Order 6920.2A, Maintenance of Water and Sanitation Systems.

* (4) Order 6930.1B, Fire Prevention and Maintenance of Fire Protection Equipment. *

(5) Order 6950.17A, Maintenance of Electrical Systems in Buildings.

(6) Order 6950.19, Practices and Procedures for Lightning Protection, Grounding, Bonding, and Shielding Implementation.

(7) Order *6950.20*, Fundamental Considerations of Lightning Protection, Grounding, Bonding, and Shielding.

Section 1. HEATING, VENTILATING, AND AIR-CONDITIONING SYSTEMS

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*
121. ROOM OR SPACE TEMPERATURE/..... HUMIDITY.[1]	NA		
a. Administrative Training, and Office ..... Area Control Setting.		HEATING 70 °F (occupied) 55 °F (unoccupied) COOLING 75 °F (occupied) 85 °F (unoccupied)	Thermostat to be set at temperature indicated. Measured space temperature may vary ±3 °F from thermostat set point.
b. Communication Equipment and Telco ..... Rooms,[1] Control Setting.		HEATING 70 °F (occupied) 55 °F (unoccupied) COOLING 75 °F (occupied) 85 °F (unoccupied)	Thermostat to be set at temperature indicated. Measured space temperature may vary ±3 °F from thermostat set point.

[1] Occupied and unoccupied space - The standards for "Unoccupied" shall apply whenever the space is to be unoccupied for 8 hours or more.

Section 1. HEATING, VENTILATING, AND AIR-CONDITIONING SYSTEMS - (Continued)

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*
c. Control Cab, TRACON, and Radar/ARTS Equipment Rooms, Control Setting.			
(1) Temperature.....		70 °F (heating) 75 °F (cooling)	Thermostat to be set at temperature indicated. Measured space temperature may vary ±3 °F from thermostat set point.
(2) Relative humidity (where humidifier ..... is installed).		30 to 55 percent	NA
d. Unoccupied Heated Areas.....		55 °F	Thermostat to be set at temperature indicated. Measured space temperature may vary ±3 °F from thermostat set point.
122. CHILLED-WATER SYSTEM[1] ..... Chilled-water design supply temperature.	271,276	NA	NA
a. Type O Towers.....		44 °F[1]	NA
b. Mock, Welton Becket Towers.....		45 °F[1]	NA
c. Other.....		Designed temperature	
123. HEATING-WATER SYSTEM[2]Heating water supply temperature (can be less in mild climates).	272,276	NA	NA
		200 °F[2]	NA
b. Mock Towers.....		160 °F[2]	NA
c. Pei, Welton Becket.....		220 °F[2]	NA
d. Other.....		Designed temperature	

[1] Value given is the basic design chilled-water supply temperature. In actual practice the chilled-water supply temperature should be set at the highest temperature that will produce the required room cooling temperature.

[2] Value given is the basic design heating water supply temperature. In actual practice the heating water supply temperature should be set at the lowest temperature that will produce the room heating temperatures listed in paragraph 121. The heating system should be kept off until absolutely needed for space heating.

Section 1. HEATING, VENTILATING, AND AIR-CONDITIONING SYSTEMS - (Continued)

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*
124. DIRECT-EXPANSION AIR-CONDITIONING			
a. Evaporators. Air temperature difference across evaporator.	273,279	At least 16 °F	NA
b. Superheat (initial installations and as required).	280	7° to 15 °F or per mfr's instructions	NA
125. HEATPUMP Low ambient temperature cutoff.		20° F or per mfr's instructions	±5 °F or per mfr's instructions
126. AIR DISTRIBUTION SYSTEM.			
a. Air Handling Units.			
(1) Airflow	273, 275	See as-built drawings	± 10 percent of rated or design flow
(2) Fan motor current	273,310	See motor nameplate	Not to exceed nameplate rating
(3) Operating speed of fans and blowers	—	See as-built drawings	± 10 percent of speed rating in rpm
(4) Airflow output at diffusers, grilles, registers, and louvers.	274	See as-built drawings	± 10 percent of rated or design flow in cubic feet per minute (cfm)
b. Filters	275		
(1) Rooftop air-conditioner		Instruction book	NA
(2) Thru-the-wall air-conditioner		Instruction book	Instruction book
(3) Filter pressure drop		As recorded when new cartridge or media is installed. Reference mfr's data.	Twice the pressure drop of new filter or see manufacturer's recommendations.
c. Duct high-temperature switches (Firestats) activate to stop fan.	Instruction book	130 °F or see as-built drawings	± 5 °F
d. Thermostat Setting for Exhaust Fans (non-air-conditioned space).			

Section 1. HEATING, VENTILATING, AND AIR-CONDITIONING SYSTEMS - (Continued)

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*
(1) Start exhaust fan	—	Above 78° F	NA
(2) Stop exhaust fan.....	—	Below 75 °F	NA
127. INSTRUMENT AIR SYSTEM	Instruction book; 277		
a. Compressor Cut-In Pressure		80 psig	±5 psig
b. Compressor Cutout Pressure.....		100 psig	±5 psig
c. Instrument Air Pressure (maximum available at instruments).[1]		20 psig	±1 psig
118.-139.RESERVED.			

[1] Generally applicable for most instruments but some require different pressure, depending upon manufacturer. Consult manufacturer data and set accordingly

Section 2. ELECTRICAL SYSTEMS

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*
140. SERVICE ENTRANCE VOLTAGE.....	Order 6950.17A	Order 6950.17A	Same as standard
141. GROUNDING PROTECTION.....	Order 6950.17A; Instruction book	Order 6950.17A	Same as standard
142. LIGHTNING PROTECTION.....	Order 6950.17A; Order 6950.19; Order 6950.20; Instruction book	Order 6950.17A; Order 6950.19; Order 6950.20; Instruction book	Same as standard
143. DC SYSTEM.....	Instruction book	Instruction book	Instruction book

Section 2. ELECTRICAL SYSTEMS - (Continued)

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*
144. OBSTRUCTION LIGHTING.....	Order 6850.5B	Order 6850.5B	Same as standard
145. MOTORS.....	Order 6950.17A		
a. Current.....	310	See motor nameplate	Not to exceed nameplate rating
b. Belt Tension	Instruction book	3/4-inch depression per foot of belt span between pulleys, or as recommended by manufacturer	Same as standard
146. POWER CONDITIONING SYSTEM (PCS) Refer to equipment instruction book for all standards and tolerances applicable to PCS equipment.	Instruction book	Instruction book	Instruction book
147.-159.RESERVED.			

Section 3. MISCELLANEOUS SYSTEMS

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*
160. HOT WATER HEATER..... Outlet temperature.	Instruction book	105 °F (approx)	NA
161. ELECTRIC WATER COOLERS ..... Outlet temperature,	Instruction book	50 °F (approx)	NA
162. SUMP PUMP.....	276,330		
a. Pump Cut-In Level.....		Instruction book	NA
b. Pump Cutout Level		Instruction book	NA
163. ELEVATORS.....	Instruction book; 332	Instruction book	Same as standard
a. Hydraulic Oil Level.....		At sight glass line	NA

Section 3. MISCELLANEOUS SYSTEMS - (Continued)

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*
b. Car Landing Level (at each floor)		Car floor level with landing	± 1/4 inch
* **164. FIRE PROTECTION SYSTEM**	Order 6930.1B	Order 6930.1B	Same as standard *
165. COMMUNICATION SYSTEM.....			
a. Meteorological and Nonautomated Air..... Traffic Control Equipment.	Order 6560.13B		
b. Intercom Equipment.....	335	Instruction book	Instruction book
(1) Resistance check.			
(2) Voltage check.			
166. CENTRAL VACUUM SYSTEM.....	334	Instruction book	Instruction book
167. SEWEGE DISPOSAL SYSTEM	Order 6920.2A	Order 6920.2A	Same as standard
168. WATER SUPPLY SYSTEM.....	Order 6920.2A	Order 6920.2A	Same as standard
169. SIGNAL LIGHT GUNS	Order 6560.13B	Order 656013B	Same as standard
170.-179. RESERVED.			

Section 4. BUILDING SYSTEMS (RESERVED)

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*
180.-199. RESERVED.			

CHAPTER 4. PERIODIC MAINTENANCE

200. GENERAL.

a. Organization. This chapter lists those activities required for ATCT environmental systems maintenance and establishes the schedule for their accomplishment.

b. Accomplishment or Scheduled Activities. Equipment variations cause certain tasks to apply only at affected ATCT's. Tasks involving HVAC equipment that is seasonally shut down may be omitted during the shutdown period. Personnel responsible for maintenance shall ensure that all applicable tasks are accomplished in the intervals specified. These requirements represent the minimum task and maximum intervals for performance and do not preclude performance of additional tasks considered desirable by the responsible maintenance organization. At locations without resident Airway Facilities personnel, the monthly maintenance activities may be extended up to a maximum of quarterly intervals to eliminate special trips for these activities.

c. Relationship to Other Publications. The following publications contain technical information and maintenance policy, criteria, guidelines, and procedures that are generally useful in the maintenance of ATCT environmental systems. These publications shall be consulted and used as needed to supplement this handbook and equipment instruction books. In case of conflict, this handbook shall take precedence.

(1) Order 1050.15, Underground Storage Tanks at FAA Facilities.

(2) Order 3900.19A, Occupational Safety and Health.

(3) Order 6560.13B, Maintenance of Aviation Meteorological Systems and Miscellaneous Aids.

(4) Order 6850.5B, Maintenance of Lighted Navigational Aids.

(5) Order 6920.2A, Maintenance of Water and Sanitation Systems.

* (6) Order 6930.1B, Fire Prevention and Maintenance of Fire Protection Equipment. *

(7) Order 6930.25, Maintenance of Structures and Buildings.

(8) Order 6940.3, Maintenance of Roads and Grounds.

(9) Order 6950.12A, Elevator Maintenance and Inspection Procedures.

(10) Order 6950.17A, Maintenance of Electrical Systems in Buildings.

(11) Order 6950.18A, Maintenance of Electrical Distribution Systems.

(12) Order 695019, Practices and Procedures for Lightning, Protection, grounding, Bonding, and Shielding Implementation.

(13) Order 6950.20, Fundamental Considerations of Lightning Protection, Grounding, Bonding, and Shielding.

(14) Order 6950.22, Maintenance of Electrical Power and Control Cables.

(15) Order 6970.3A, Maintenance of Environmental Systems.

(16) Order 6980.11B, Maintenance of Engine Generators.

(17) Order 6980.25B, Maintenance of Batteries for Standby Power.

(18) Applicable state and local codes.

Section 1. HEATING, VENTILATING, AND AIR-CONDITIONING SYSTEMS

Maintenance Activities	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
201. MONTHLY.[1]		
a. HVAC Equipment. Visually inspect HVAC equipment and systems.... Check indicators on equipment. Also check for:	121 through 127	Instruction book; 271 through 289
(1) Any vibrations, short cycling of equipment, unusual noises, or abnormal conditions, including frayed or loose belts.		
* (2) Water, refrigerant, oil, or other fluid leaks from the HVAC system.		
(3) Check all air filters including ventilation filters. Clean and reactivate permanent types, and replace disposable types, if required.		*
b. Hot Water/Steam Boilers.....	Instruction book	Instruction book
(1) Open blowdown on boiler water level controls to ensure that connections are clear; close valve.		
(2) Check condition of flame detectors for soot or other deposits. Clean as necessary.		
(3) Test and adjust as necessary all safety devices except safety relief valve.		
(4) On oil-fired boilers inspect nozzle, oil filter cartridge, and oil pump strainer. Clean electrodes, burner fan, burner housing, and air handling parts.		
(5) Check fuel level in storage tank and replenish as necessary.		
c. Water Treatment	Locally established	Instruction book; 278
(1) Check water treatment equipment serving chilled, heating, and boiler water systems.		
(2) Check water condition for adequate treatment program.		
d. Heating Water System[1].....	123	Instruction book 272, 276
(1) Check heating water supply and return temperature indicators.		
(2) Check heating water pump suction and discharge pressure gauges.		
(3) Check water level of expansion tank.		

[1] Tasks involving heating and cooling equipment that is seasonally shut down shall be omitted during the shutdown period. Heating and cooling equipment shall be readied for operation at least 30 days prior to the anticipated date the equipment is required.

Section 1. HEATING, VENTILATING, AND AIR-CONDITIONING SYSTEMS - (Continued)

Maintenance Procedures	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
e. Chilled-Water Systems[1]	122	Instruction book; 271, 276
(1) Check chilled-water supply and return temperature indicators.		
(2) Check chilled-water pump suction and discharge pressure gauges.		
f. Standby Equipment. Rotate operation of any standby equipment.....	NA	Instruction book
g. Instrument Air System	127	Instruction book
(1) Drain water from compressor receiver, pipeline filters, and moisture traps.		
(2) Verify operation of refrigerated air dryer and automatic blowdown traps.		
202. QUARTERLY.		
a. Air Distribution System.		
(1) Check HVAC equipment fan drives; replace belts or adjust if necessary.	NA	Instruction book
(2) Check blower bearings and lubricate if required	NA	Instruction book
(3) Check all air intake and exhaust openings, screens, louvers, etc., for obstructions.	126	Instruction book
(4) Check all air filters including ventilation filters. Clean and reactivate permanent types, and replace disposable types if required.	126	Instruction book
* **b. Direct Expansion Systems.** Check operation of compressor ..... crankcase heaters. Check oil level.	124	Instruction book *
c. Instrument Air System	127	Instruction book
(1) Check oil level in compressor crankcase.		
(2) Check condition of drive belts, and adjust/replace belts as required.		

[1] Tasks involving heating and cooling equipment that is seasonally shut down shall be omitted during the shutdown period. Heating and cooling equipment shall be readied for operation at least 30 days prior to the anticipated date the equipment is required.

Section 1. HEATING, VENTILATING, AND AIR-CONDITIONING SYSTEMS - (Continued)

Maintenance Activities	*Reference Paragraph*	
	Standards and Tolerance	*Maintenance Procedures*
d. Evaporative Condenser Water Systems.....	Instruction book	Instruction book
(1) Inspect evaporative condenser sump and pump inlet strainer for scale. Clean as required.		
(2) Check evaporative condenser for proper water flow and water level in sump.		
(3) Inspect evaporative condenser fan drive.		
203. START OF HEATING SEASON.		
NOTE: Heating equipment shall be readied for operation at least 30 days before anticipated use.		
a. Systems and Equipment Shutdown.....	NA	Instruction book
(1) Remove from service all systems and equipment not required for facility operation during the heating season. Follow applicable instructions for equipment shutdown procedures.		
(2) Ensure that all water systems exposed to freezing weather have been completely drained and properly winterized.		
(3) Take proper precautions to protect equipment that might be damaged by drifting snow, freezing, and ice formation.		
b. Systems and Equipment Startup (Heating Water, Warm Air, and Steam Systems)....	Instruction book	Instruction book
(1) Clean flame detector lens and check scanner cell.		
(2) Check burner air dampers and control linkage operation. Remove accumulated lint or dirt and repair as necessary.		
(3) Inspect fuel strainers. Clean or replace as necessary.		
(4) Inspect anodes; replace magnesium rods if required.		
(5) Check operation of all boilers and furnace burners. Check for smooth ignition, proper combustion, condition of electrodes, and safety pilot flame. Clean or adjust as required.		
(6) Check the water supply temperature from the converter.		
(7) Check the water return temperature to converter.		

Section 1. HEATING, VENTILATING, AND AIR-CONDITIONING SYSTEMS - (Continued)

Maintenance Activities	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
(8) Check the boiler steam pressure or water temperature. Adjust controls if necessary.		
(9) Check all air filters and clean or replace as necessary.		
c. Gas Burners. Inspect regulators and vent screens. Adjust or clean..... as required.	Instruction book	Instruction book
d. Rotary Type Oil Burners. Check atomizing cup, refractory, and oil..... distribution.	Instruction book	Instruction book
e. Oil-Atomizing Nozzles. Check nozzles and clean if necessary.....	Instruction book	Instruction book
f. Warm Air Furnace. Check operation of all safety and limit controls	Instruction book	Instruction book
g. Hot Water and Steam Plants. Check operation of all safety and..... limit controls.	Order 6970.3A; Instruction book	Instruction book
h. Boiler and Furnace Bloiver Motors and Bearings. Check motors..... and bearings and lubricate as necessary.	Instruction book	Instruction book
i. Boiler and Furnace Combustion. Clean combustion side of all..... boilers and furnaces as necessary. Adjust burner as required.	Instruction book	Instruction book
j. Boiler Safety Relief Valves. Test all relief valves by actual..... operation of test handle.	Instruction book	Instruction book
k. Boiler Water. Flush, inspect, and refill water side of all steam..... boilers. Operate boiler at least 2 hours after refilling to eliminate dissolved oxygen from the water.	Instruction book	Instruction book
l. Radiators. Check all vents and traps. Replace, repair, or clean as ..... required.	NA	NA
m. Pumps. Inspect heating water circulating pump and motor..... Lubricate as necessary.	NA	276
n. Condensate Pump. Check condensate pump and motor.....	NA	276
o. Electric Duct or Baseboard Heaters. Check resistance coils for lint .... and dust. Clean as necessary. Check operation of resistance heaters.	NA	288
p. Unit or Space Heaters. Check heating elements, fan, guard, and..... motor. Clean or lubricate as necessary. Check burner and controls on gas-fired units.		

Section 1. HEATING, VENTILATING, AND AIR-CONDITIONING SYSTEMS - (Continued)

Maintenance Activities	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
q. Pulley and Sheavs. Check all pulleys and sheaves for alignment, ... wear, and security of mounting. Repair or replace as necessary.	NA	Instruction book
r. Drive Belts. Check all equipment drive belts for wear and belt ..... tension. Replace as necessary.	NA	Instruction book
s. Expansion Tanks. Check tank for proper water level, external ..... corrosion, and leaks. Repair as necessary.	NA	Instruction book
t. Humidifiers. Check humidifier operation and control setting, and ..... perform the following tasks as necessary.	NA	Instruction book
(1) Check humidifier for corrosion and scale; clean if necessary.		
(2) Inspect all humidifier drains for obstruction, corrosion, and algae; clean or repair as necessary.		
(3) Steam type.		
(a) Check trap and strainer.		
(b) Check distributor pipe and steam orifices.		
(4) Water type.		
(a) Inspect and lubricate motor.		
(b) Clean waterline strainer, solenoid valve, and orifice.		
(c) Clean drain pan and flush drain line.		
(d) Replace water distribution media.		
(e) Clean float and valve if so equipped.		
u. Fuel Storage	NA	Order 1050.15; 337
(1) Check fuel oil storage system. Check tanks for leaks, water, and sludge. Repair and remove water and sludge as necessary.		
(2) Check air vents for obstruction.		
(3) Renew tank identification as necessary.		

Section 1. HEATING, VENTILATING, AND AIR-CONDITIONING SYSTEMS - (Continued)

Maintenance Activities	Reference Paragraph	
	Standards and Tolerances	*Maintenance Procedures*
v. Chimneys and Breech Pipes.....	NA	360
(1) Metal. Inspect for rust, corrosion, leaks, and soot accumulation. Repair and remove soot as necessary.		
(2) Masonry. Inspect for cracks, leaks, and soot accumulation. Repair and remove soot as necessary.		
w. Heating and Domestic Hot Water Systems. Check operation of all ..... safety and limit controls.	NA	Order 6970.3A; Instruction book
x. Heat Pumps.....	Instruction book	Instruction book
(1) Check heat pump operation in both heating and cooling modes.		
(2) Check both indoor and outdoor refrigerant coils and clean as required.		
(3) Inspect all fans, motors, and drives. Lubricate fans and motors as required.		
(4) Check operation of auxiliary heating coils.		
(5) Check control operation in both heating and cooling modes. Check operation of diverter.		
204. START OF COOLING SEASON.		
NOTE: Cooling equipment shall be readied for operation at least 30 days before anticipated use.		
a. Systems and Equipment Shutdown. Remove from service all ..... systems and equipment not required for facility operation during the cooling season. Follow applicable instructions for equipment shutdown procedures.	NA	Order 6970.3A; Instruction book
b. Systems and Equipment Startup.....	NA	Instruction book
(1) Auxiliary Systems and Equipment.		
(a) Check all pumps for unusual noise, vibration, leaks, or other signs of malfunction.		276, 310, 330
(b) Check all pulleys and sheaves for alignment, wear, and security of mounting. Replace or adjust as necessary.		Instruction book

Section 1. HEATING, VENTILATING, AND AIR-CONDITIONING SYSTEMS - (Continued)

Maintenance Activities	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
(c) Check all equipment drive belts for wear and tension ..... Replace or adjust as necessary.		Instruction book
(d) Clean all condensate drains and drain pans. Chemically ..... treat to control algae as necessary.		284
(e) Check all air filters and clean or replace as necessary		275
c. Chilled-Water System	122	Instruction book; 271
(1) Check chiller compressor oil level.		
(2) Inspect for water leaks.		
(3) Inspect auxiliary equipment and chilled-water pumps for unusual noises, vibrations, or other signs of malfunction.		
(4) Check the chilled water supply temperatures.		
(5) Check the chilled water return temperature.		
d. Condenser Water System.....	Instruction book	Instruction book; 278
(1) Clean makeup float valve and check for proper operation.		
(2) Clean system strainers and check interior of piping for scale and corrosion		
(3) Remove scale from cooling tower and basin and flush thoroughly with water.		
(4) Remove scale from evaporative condenser and basin and flush thoroughly with water.		
(5) Check condenser internally for scale and clean as necessary.		
e. Direct-Expansion Systems (including central, self-contained..... roof-mounted and split systems).	Instruction book 124	Order 6970.3A; Instruction book
(1) Check operation of air conditioner. Inspect evaporator fan, drive, and motor. Lubricate fan and motor as required. Inspect evaporator coil and clean as required.		

Section 1. HEATING, VENTILATING, AND AIR-CONDITIONING SYSTEMS - (Continued)

Maintenance Activities	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
(2) Check temperature of air entering and leaving evaporator. (3) Check operation of condensing unit. Inspect fan, drive, and motor. Lubricate fan and motor if required. Inspect condenser coil and clean if required. (4) Check compressor oil sight glass on units equipped with sight glass. (5) Check condensate drain system for obstructions and clean as necessary. (6) Check compressor crankcase heater. (7) Check refrigerant sight glass. (8) Check refrigerant filter-drier.		
f. Window and Through-the-Wall AC units. Check the following	Instruction book	Order 69703A; Instruction book
(1) Temperature of air entering and leaving the evaporator. (2) Inspect evaporator and condenser coil and clean as required. (3) Inspect condensate drain system and clean as required. (4) Check evaporator and condenser fan and motor. Clean and lubricate as required. (5) Test time delay start feature by cycling unit.		
g. Heat Pumps	Instruction book	Instruction book
(1) Check heat pump operation in both heating and cooling modes. (2) Check both indoor and outdoor refrigerant coils and clean as required. (3) Inspect all fans, motors and drives. Lubricate fans and motors as required. (4) Check operation of auxiliary heating coils. (5) Check control operation in both heating and cooling modes. Check operation of diverter.		

Section 1. HEATING, VENTILATING, AND AIR-CONDITIONING SYSTEMS - (Continued)

Maintenance Activities	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
205. ANNUALLY. **NOTE:** Annual tasks should be accomplished in conjunction with seasonable startup of equipment where feasible.		
a. Heating Equipment. During the cooling season, inspect heating equipment for deterioration of painted surfaces and repair or repaint as necessary.	NA	NA
b. Air-Conditioning and Ventilating Equipment. During the heating season, inspect air-conditioning and ventilation equipment for deterioration of painted surfaces and repair or repaint as necessary.	NA	NA
c. Instrument Air Systems	127	Instruction book; 277
(1) Change oil in compressor crankcase.		
(2) Check air intake filters. Replace if necessary		
(3) Clean compressor cooling fins.		
(4) Manually operate receiver safety valve to verify that it will function.		
(5) Check operation of refrigerated air drier. Clean condenser as necessary.		
d. Control System. Check all HVAC controls and safety devices for proper operation. Repair as necessary.	NA	Instruction book
e. Piping System	NA	Order 6970.3A
(1) Check piping, valve fittings, piping supports and insulation. Repair as necessary.		
(2) Repair all system leaks. Clean all strainers and drip legs.		
f. Diffusers, Grilles, and Registers. Check airflow if an air distribution problem is indicated.	126	Instruction book; 273, 274
g. Motors	145	Order 6950.17A; Instruction book; 310

Section 1. HEATING, VENTILATING, AND AIR-CONDITIONING SYSTEMS - (Continued)

Maintenance Activities	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
(1) Inspect all motors and lubricate as required.		
(2) Clean all ventilation ports.		
(3) Check load current and compare with nameplate current rating.		
h. Emergency Equipment. Verify that all emergency or standby HVAC equipment is operable.	NA	Instruction book
206.-219. RESERVED.		

Section 2. ELECTRICAL SYSTEMS

Maintenance Activities	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
* **220. WITHDRAWN--CHG 1** *		
221-225. RESERVED.		
226. QUARTERLY. Perform the following checks on battery-operated emergency lighting units.		
a. Test operate light for 5 seconds	NA	Instruction book
b. Check battery charger operation; repair if necessary	Instruction book	Instruction book
c. Perform dc power supply battery maintenance as required	Order 6980.25B	Order 6980.25B
227. ANNUALLY.		
a. Motor Starters and Distribution Panels	NA	Order 6950.17A
(1) Open enclosure and inspect equipment.		
(2) Check that all equipment identification labels are in place.		
b. Electrical Manhole	NA	NA
(1) Check waterproof cover seal.		
(2) Examine cables for signs of damage.		

Section 2. ELECTRICAL SYSTEMS - (Continued)

Maintenance Activities	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
(3) Pump out any accumulated water and remove debris.		
c. Grounding System. Check ground resistance, if grounding problem..... is indicated.	Order 6950.17A	Order 6950.17A
* **d. Withdrawn--CHG 1**		*
e. Lightning Protection.[1] Make a through inspection of all lightning..... protection equipment. Repair or replace parts as required.	Order 6950.19, Order 6950.20	Order 6950.19, Order 6950.20
f. Terminals. Inspect terminal connections and tighten if required	NA	Order 6950.17A
(1) Equipment and system grounds.		
(2) Motors, disconnect switches, , motor switches, and distribution panels.		
228.-229. RESERVED.		

[1] Items susceptible to storm damage should be checked after each severe storm.

Section 3. BUILDING SYSTEMS

Maintenance Activities	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
230. SEMIANNUALLY. **a. Weatherproofing and Drainage.**[1] Thoroughly inspect building weatherproofing for the following. Correct as necessary or report condition to proper authority (supervisor).		

[1]Items susceptible to storm damage should be checked after each severe storm.

Section 3. BUILDING SYSTEMS - (Continued)

Maintenance Activities	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
(1) Leaks..... (a) Thru-the-wall air-conditioners (at wall penetration).	NA	353, 364
(b) Roof top air-conditioners (at roof penetration).		
(c) Flashing.		
(d) Horizontal and vertical paneling joints (seams).		
(e) Roofing. Check for wrinkles cracking, exposed felt, bare spots, splitting of surface, blistering, and dried-out areas.		
(2) Drainage system.....	NA	NA
(a) Verify that gutters, valleys, overflow scuppers, strainers, and downspouts are free of debris. Check gutter and downspout hangers. Check that splash block is in place.		
(b) Inspect storm drainage system. Check accumulation of debris at catch basins and storm inlets. Remove covers of all storm water inlets and check for silt and debris. Unclog or clean as required to insure adequate storm water drainage.		
* **b. Withdrawn--CHG 1**		
c. Withdrawn--CHG 1		*
231. ANNUALLY.[1]		
a. Interior Systems. Thoroughly inspect the following. Correct as * necessary or report condition to proper authority (supervisor) as required.		*
(1) Inspect the underside of the roof. Check for water spots, stains, ... or discoloration that indicates water leaks. Check for damage, loose, or missing ceiling tile.	NA	Order 6930.25, 353

Section 3. BUILDING SYSTEMS - (Continued)

Maintenance Activities	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
(2) Check handrails, ladders, stairs and disappearing-stairs pivot points and springs. Repair as required.	NA	Order 6930.25
(3) Check all trapdoors and roof hatches for proper operation and water tightness.	NA	Order 6930.25
(4) Inspect gypsum board and metal wall paneling for deterioration	NA	Order 6930.25
(5) Inspect doors, locks, and windows. Check for damages defective caulking, deterioration, termite infestation, or leakage. Repair as required.	NA	Order 6930.25
(6) Check interior paint. Touch up as required	NA	
b. Exterior Systems. Inspect the following. Correct as necessary or report * condition to proper authority (supervisor) as required.		*
(1) ATCT structures. Check all railings, ladders and rungs, open structural steel, walk gratings, antenna supports, louvers, platforms, and vents for broken welds, missing nuts and bolts, deterioration, rust, and corrosion. Repair structure and touch up paint as required.	NA	Order 6930.25
(2) Parking area and walkways. Inspect parking area, driveway, and walkway. Check for the following and repair as required or report condition to proper authority (supervisor).	NA	Order 69403
(a) Cracked or damaged walkways and roadways.		
(b) Proper drainage.		
(c) Deterioration of surface.		
(3) Tower foundation. Inspect ATCT foundation for the following and repair as required or report condition to proper authority (supervisor).	NA	Order 6930.25; 362
(a) Deterioration of concrete foundation.		
(b) Soil erosion near foundation.		
(c) Foundations cracks.		
(4) Tower wall panels. Inspect panels for rust. Paint as required	NA	361,365
* **c. Facility Identification and Warning Signs**. Check that signs are ..... legible and clearly visible. Correct as required.	NA	350 *
232.-249. RESERVED.		

Section 4. MISCELLANEOUS SYSTEMS

Maintenance Activities	Reference Paragraph: Standards and Tolerances	Reference Paragraph: Maintenance Procedures
* **250. WEEKLY** Fire Protection System. Perform all applicable maintenance tasks listed in Order 6930.1B.	Order 6930.1B	Order 6930.1B *
251. MONTHLY.		
a. Door Alarm System. Check system for proper operation	NA	Instruction book
* **b. Fire Protection System.** Perform all applicable maintenance tasks listed in Order 6930.1B.	Order 6930.1B	Order 6930.1B
c. Fire Alarm and Smoke Detection System. Perform the following in addition to the tasks in Order 6930.1B.	NA	Order 6930.1B; Instruction book; 331 *
(1) Pull all alarm stations and check operation; repair as necessary.		
(2) Check alarm bell at each station for proper operation; repair as necessary.		
(3) Check operation of detector system.		
252. QUARTERLY.		
a. Window-Washing System	NA	Instruction book
(1) Check washer operation.		
(2) Test operation of air cylinders on window washer.		
(3) Lubricate drive mechanism as necessary.		
(4) Drain moisture accumulation from air tank.		
b. Track-Mounted Window-Washing Personnel Carrier	NA	Instruction book
(1) Check battery power system. Make repairs as necessary.		
* (2) Inspect track roller mechanism with each use and lubricate as necessary.		
253. SEMIANNUALLY.		
a. Fire Protection System. Perform the following tasks in addition to the tasks in Order 6930.1B.	Order 6930.1B	Order 6930.1B Instruction book *

Section 4. MISCELLANEOUS SYSTEMS - (Continued)

Maintenance Activities	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
(1) Insure that the fire exits are unobstructed and that doors operate properly. (2) Check condition of “Fire Exit" signs and repair as required.		
* **b. Elevators**.....	163	Order 6950.12B; Instruction book; 332 *
(1) General.		
(a) Check for proper starting and stopping.		
(b) Check operation for unusual noises. Locate the cause and correct.		
(c) Inspect equipment in machine room for proper operation and correct as necessary.		
(d) Check oil level in hoisting machine; add oil if necessary.		
(e) Check condition of motor commutators and brushes; replace as necessary.		
(2) Door operating mechanism.		
(a) Clean door sill channels.		
(b) Check door for proper operation.		
(c) Clean and lubricate door operating mechanism if necessary.		
(d) Check setscrews and keys for tightness; tighten if necessary.		
(e) Check all door contacts for wear and damage; adjust or repair if necessary.		
(f) Check door leading switch and adjust if necessary.		
(g) Check shafts and bearings for wear. Lubricate and/or replace parts as required.		
(h) Check for proper door alignment; realign if necessary.		
(i) Check rollers for proper operation; repair if needed.		

Section 4. MISCELLANEOUS SYSTEMS - (Continued)

Maintenance Activities	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
(j) Check electrical and mechanical interlocks for proper operation.		
(k) Check door operation with emergency key.		
(3) Control and operating devices.		
(a) Check control panel, hoisting, and car control devices for loose connection, damaged contacts, or other obvious defects. Correct faults as necessary.		
(b) Observe the signal system for normal operation.		
(c) Test operate the emergency stop switch.		
(d) Test operate the alarm bell.		
(4) Leveling. Check leveling switch for proper operation. Adjust switch as required.		
(5) Brakes. Check condition of brakes and adjust if necessary.		
(6) Cars.		
(a) Check retiring cam for proper operation; adjust if necessary.		
(b) Check door operator motor and drive operation; adjust if necessary.		
(c) Check ventilation fan and grille; clean and lubricate if necessary.		
(7) Hoisting machine controller.		
(a) Clean and align relay contacts; replace if necessary.		
(b) Check tightness of terminals and relay connections.		
(c) Inspect fuses for proper seating in fuseholders.		
* **c. Withdrawn--CHG 1** *		
d. Sump Pumps. Check sump pump for proper operation; lubricate if needed.	NA	330

Section 4. MISCELLANEOUS SYSTEMS - (Continued)

Maintenance Activities	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
* **e. Withdrawn--CHG 1**		*
f Electric Water Cooler. Check water temperature and clean condenser.	161	Instruction book
* **g. Withdrawn--CHG 1**		*
h. Domestic Water Booster System	NA	Instruction book
(1) Check pump operation.		
(2) Check pump and motor bearings and lubricate if required.		
(3) Check drive coupling and inspect for leaks at pump packing gland or seal.		
(4) Check compression tanks (hydrocells).		
i. Vacuum Cleaning System	NA	Instruction book; 334
(1) Check filter bag and clean or replace as necessary.		
* (2) Withdrawn--CHG 1		*
(3) Lubricate power unit if necessary.		
254. ANNUALLY.		
* **a. Fire Protection System.** Check the following	NA	Order 6930.1B; Instruction book *
(1) Portable fire extinguishers.		
(2) Alarm, fire, and smoke detection system.		

Section 4. MISCELLANEOUS SYSTEMS - (Continued)

Maintenance Activities	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
(3) Smoke suppression system.....	NA	332
* (4) Perform other applicable tasks identified in Order 6930.1B.		*
b. Elevators and Hoists.....	NA	Order 6950.12A; Instruction book; 332
* **NOTE**: The following work shall be performed by a licensed elevator inspection firm in accordance with American National Standard (ANSI) A17.1 and A17.2 and applicable local/state requirements.		
(1) Check all painted surfaces for rust. Clean and paint areas if necessary.		
(2) Check safety devices for proper operation; correct if necessary.		
(3) Check car shoe gibs for wear; replace if necessary.		
(4) Check door gibs for wear; replace if necessary.		
(5) Motors and motor generators.		
(a) Clean ventilation openings.		
(b) Check bearing lubrication; lubricate if required.		
(c) Check ac current input under normal load and compare it with motor nameplate.		
(6) Check hoisting machine controller operation. Inspect contacts.		
(7) Sheaves.		
(a) Check for tightness on shafts.		
(b) Check for wear in cable grooves.		
(c) Check setscrews and keys for tightness; tighten if required.		
(8) Elevator shaft and pit.		
(a) Check condition of guide rails and fastenings.		
(b) Check limit and terminal stop switches.		*

Section 4. MISCELLANEOUS SYSTEMS - (Continued)

Maintenance Activities	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
* (c) Check and refill guide rail oilers.		
(d) Inspect pit and clean if necessary.		
(e) Check spring buffers and their supports.		
(9) Check traveling cable for wear, condition of insulation, and hanging supports.		
(10) Doors.		
(a) Lubricate tracks and hangers and clean if necessary.		
(b) Check door operation; adjust if necessary.		
(c) Check condition of sills, gibs, headers, and fastenings.		
(d) Check door interlock contacts.		
(11) Wire ropes.		
(a) Check condition of traction machine ropes; lubricate as required.		
(b) Check condition of counterweight ropes; lubricate as required. *		
c. Automatic Window-Washing System. Perform annual maintenance..... indicated in instruction book. Also perform the following.	NA	Instruction book
(1) Examine power unit casing for corrosion. Clean and touch up paint as required.		
(2) Examine hose and attachments. Replace or repair worn or damaged equipment as required.		
d. Domestic Water Heaters. Check water heater operation. Open..... drain valve and flush tank thoroughly. Close drain valve after completion of flush operation.	NA	333
e. Signal Light Guns.....	Order 6560.13B	Order 6560.13B
255.-269. RESERVED.		

CHAPTER 5. MAINTENANCE PROCEDURES

270. GENERAL.

This chapter establishes the procedures for accomplishing the various essential maintenance activities listed in chapter 4 on a periodic or incidental basis. The chapter is divided into four sections. Section 1 describes the procedures for maintenance of HVAC systems. Section 2 describes the procedures for maintenance of electrical systems. Section 3 describes the procedures for maintenance of miscellaneous systems. Section 4 describes the procedures for maintenance of building systems. Refer to Order 6000.15B for additional general guidance.

Section 1. HEATING, VENTILATING, AND AIR-CONDITIONING SYSTEMS

271. EVALUATION OF CHILLED-WATER SYSTEM PERFORMANCE.

a. Discussion. Proper operation of the chilled-water system is verified by evaluating performance data collected as prescribed in chapter 4. If evaluation of readings indicates improper performance, corrective action shall be taken to restore the system to operating tolerances specified in chapter 3. Proper system performance can be assured only if the following requirements are met:

(1) System Water Flow. Supply valves must be properly positioned to provide the correct flow of chilled water.

(2) Individual Machine Controls. The controls on each unit must be set so that when operating, the machine can maintain the required temperature.

b. Calculating Load. Knowledge of the operating capacity of a chiller system is useful in diagnosing system problems. Chiller load may be calculated as follows:

(1) Record chilled-water temperature difference (return minus supply) at unit where load is to be calculated.

(2) Record chilled-water flow in gallons per minute (gpm) through unit for which load is to be calculated. The flow rate may be approximated by referring to the chilled-water pump capacity curve.

(3) Determine load in tons by using the formula:

$$\text{Load (tons)} = \frac{\text{GPM} \times \text{Temp. Difference}}{24}$$

(4) Compare result with nameplate rating of unit.

272. EVALUATION OF HEATING-WATER SYSTEM PERFORMANCE.

a. Discussion. Proper performance of heating water systems is verified by evaluating performance data collected as prescribed in chapter 4. If evaluation of readings indicates improper performance, corrective action shall be taken to restore the system to specified operating tolerances. For proper system operation, the flow of system heating water must be maintained at a flow rate and temperature that will insure that all system branches or zones are properly supplied.

b. Procedure.

(1) Verify that heating system valves are in the proper operating position.

(2) Insure that leaving-water temperature from the boiler is within the tolerance specified in chapter 3. Adjust controls if required; refer to the instruction book.

(3) Verify that the difference between system supply and return water temperature is compatible

with historical records for similar load conditions. Higher or lower than normal differences may indicate over or under circulation of water through a heating coil. Check suspected heating-coil air-discharge temperatures and related temperature control valves and controllers for proper operation. Adjust controls or repair as necessary.

273. EVALUATION OF AIR DISTRIBUTION SYSTEM PERFORMANCE.

a. Discussion. The main criteria for evaluation of air distribution system performance is whether or not the room or space temperature, humidity and/or ventilation requirements specified in chapter 3 are being met. If the specified tolerances for system performance are exceeded, the remedy may be as simple as readjusting a temperature controller or room thermostat, or may require extensive analysis and possible adjustment of secondary controls or devices. The following information should be used as a guide to solution of common problems that may be experienced.

b. Inadequate Cooling or Heating. The most probable causes of inadequate cooling or heating are malfunctioning or misadjusted temperature controls and inadequate circulation of heating or chilled water through coils. Another possible cause is airflow that is too high or too low because of improper fan speed, damper or louver malfunctions, or blockage of filters or coils from accumulated dirt. Air distribution systems were balanced at installation. If all preventive maintenance tasks defined in chapter 4 are accomplished as required, it should not be necessary to periodically check airflow unless trouble occurs that cannot be attributed to anything other than improper fan speed. Indiscriminate tinkering with fan speed adjustments should be avoided. Airflow measurement is accomplished, if required, by following procedures in paragraph 274. Airflow values for proper system balancing are recorded in air circulation data contained in the as-built drawings. Airflow should never exceed the values specified. Excessive airflow may cause any of the following problems:

(1)Heating coil unable to adequately heat airstream.

(2) Humidifier unable to adequately humidify airstream.

(3)Cooling coil unable to adequately cool airstream.

(4) Moisture can be carried off cooling coil into airstream.

(5) Drafts in the conditioned space.

c. Cycling of Temperature Controls. Stable air discharge temperatures from cooling or heating coils is desirable, even if slight deviations from specified control throttling ranges is required to obtain stability. Unstable air discharge temperatures will cause the associated temperature receiver-controller and temperature control valve to cycle, thereby increasing cycling of coil discharge temperature. To eliminate cycling and stabilize temperature, widen the throttling range adjustment of the receiver-controller.

274. AIRFLOW MEASUREMENT.

a. Discussion. One function of an air-conditioning system is to deliver a certain amount of air to a particular area in a given period of time. Occasionally in connection with troubleshooting system performance, it will be necessary to verify that the airflow at various points in an air distribution system is within the parameters required for proper operation, and if not, to take the corrective action necessary to obtain the required flow. Airflow measurements are made within ductwork and at suction and pressure openings of the system.

b. Test Equipment Required. Alnor Velometer, Series 6000, or equal.

c. Procedure.

(1) Prepare Velometer.

(a) Insert pitot probe firmly into appropriate range selector until probe is seated.

(b) Use double hose to connect ranger selector to Velometer, taking care to connect positive to positive and negative to negative.

(2) Measure air velocity at suction and pressure openings.

NOTE: When taking measurements, pointer on pitot probe must point toward suction openings and away from pressure openings.

(a) Measure size of core at test opening, and compute area in square units.

(b) Mark off core into at least nine equal square areas (preferably more). See figure 5-1.

(c) Place pitot probe parallel to center of each area, against grille for suction openings, and 1 inch (2.5 cm) from grille for pressure openings. Take reading at each area, and average these readings to obtain total airflow velocity in units per minute.

(3) Measure air velocity within ductwork.

NOTE: It is necessary to have openings in duct wall at point where measurement is to be made. If no openings are available, drill at least three 5/8-inch (160 mm) diameter holes in a line perpendicular to the duct run. Measure duct height (or width) where measurement is to be made, and mark off in at least three equal spaces. Drill one hole at the center of each space as shown in figure 5-2. Cover holes after completing airflow measurement. Do not drill test holes closer than 10 feet (3 meters) down-stream of a turn, transformation, damper, or other source of turbulence.

(a) Measure size of duct at test holes, and compute area in square units.

(b) Divide the duct into at least nine equal square areas (preferably more).

(c) Insert probe into hole with arrow on probe pointing in direction of airflow. Take a Velometer reading at the center of each area, and average these readings to obtain duct airflow velocity in units per minute.

(4) Compute air quantity. Use the following formula to compute airflow quantity at test areas:

Q = kAV where
Q = air quantity in cubic units per minute
A = duct cross section in square units
V = average flow velocity in units per minute
k = grille factor (See Velometer instruction book.)

(5) Compare result. Compare airflow quantity measurement with value listed in facility as-built drawings.

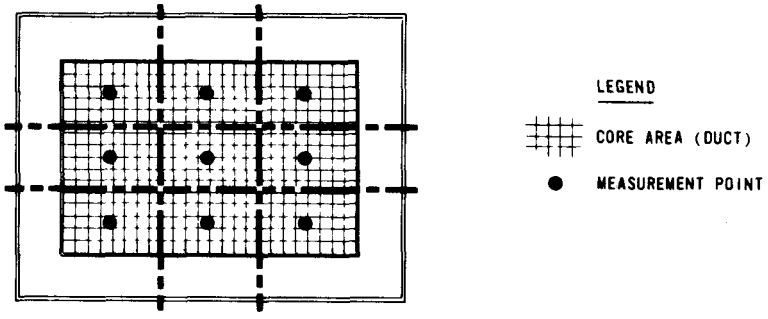


Figure 5-1. Airflow Measurement Points at Grilles

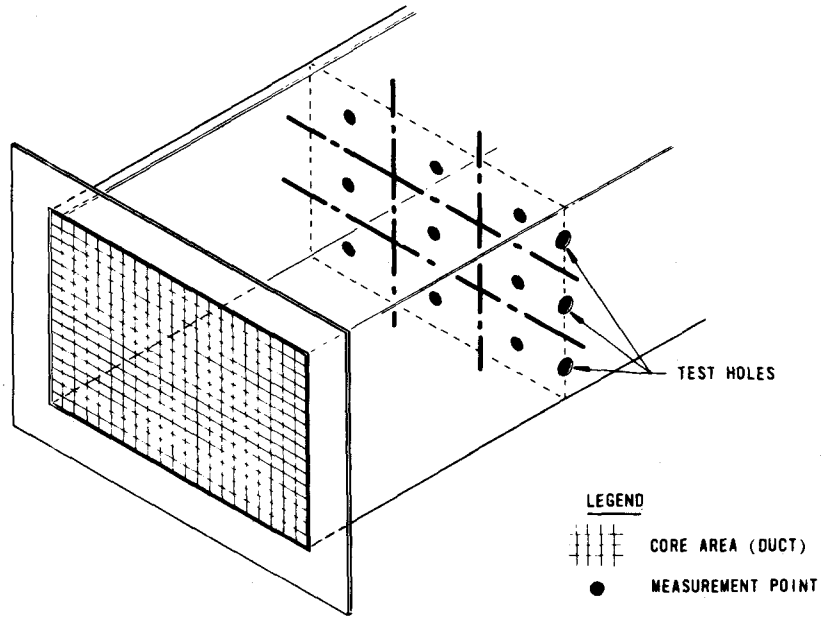


Figure 5-2. Airflow Measurement Points Within Ductwork

275. EVALUATION OF AIR FILTER PERFORMANCE.

a. Discussion. Air filters are installed in air distribution systems to remove dust and other airborne particles from the airstream. Over a period of time, a filter becomes loaded and builds up resistance to airflow. The rate of loading depends on the type and concentration of particles in the air being handled and upon the operation cycle of the system. For this reason, the periods between maintenance cannot be predicted with certainty. Manometers or draft gauges are installed on many filters to measure the pressure drop across the filter or filter bank to indicate when the filter requires servicing. These gauges should be used as the routine guide, but all filters, whether equipped with draft gauges or not, should be periodically inspected. Some types of filters contain an adhesive or oil that may dry out over a period of time. As the filter dries out, dirt clinging to it may break loose, thus reducing the resistance indicated on the gauge. Therefore, the gauge reading should not be relied on as the only criteria for servicing. When inspection reveals that servicing is required, cartridges should be replaced or the media renewed. Under no circumstances shall cleaning of a throw-away cartridge type filter be attempted.

b. Procedure.

(1) After installing new filters, observe draft gauge and mark reading on gauge.

(2) Periodically check draft gauge to verify that operating limits specified in chapter 3 have not been exceeded. Inspect filter condition.

(3) If filter requires replacement, do this when the unit can be shut down without jeopardizing the environmental conditions in areas served. Most units serving critical areas may be shut down for brief periods during off-peak hours. Refer to equipment instruction book for filter replacement data and procedures as required.

(4) If hazardous particulates, such as asbestos, have been identified in the air supply, the contaminated air filters removed from air handling equipment should be disposed of according to the local guidelines for the disposing of hazardous waste.

276. EVALUATION OF PUMP PERFORMANCE.

a. Discussion. The liquid pumps used for circulation of heating and chilled water are rated in gpm of delivery at

various pumping heads. Manufacturers' pump ratings and head-capacity curves for new pumps provide useful data, which is used to evaluate pump performance. Operating pump inlet (suction) and outlet (discharge) pressures should be periodically checked against the manufacturers' performance data to insure that performance has not been significantly degraded. Also, it is desirable that the "no-flow" pump head be checked by momentarily closing the pump discharge valve long enough to observe the discharge pressure under this condition. If the no-flow head has dropped from the new-pump rating, a pump deficiency such as a worn impeller is indicated.

b. Procedure.

(1) Record pump pressures at no-flow and rated-flowing condition.

(2) Compute pump head in feet of water by multiplying the pressure differential across pump in psig by 2.31.

(3) Close pump discharge valve momentarily and read no-flow discharge pressure; open valve.

(4) Compute no-flow head in feet of water.

(5) Compare calculated heads at flow and no-flow against manufacturers' performance data Low pump head at no-flow indicates a problem in the pump; if flow head is significantly off of pump curve, but no-flow head is satisfactory, the problem is in system piping, valves, coils, etc.

(6) Troubleshoot and repair pump or system piping deficiency. (Refer to equipment instruction book for pump troubleshooting information.)

277. EVALUATION OF INSTRUMENT AIR SYSTEM PERFORMANCE.

a. Discussion. Satisfactory operation of the entire HVAC system depends upon the availability, stability of regulation, and quality of compressed air supplied to the pneumatic controls and control devices. The instrument air system supplies air, which is regulated at a constant pressure and is clean, dry, and free of oil. All maintenance activity on this system is dedicated to monitoring performance to insure availability of air at the required pressures and to performing those tasks required to insure delivery of clean, dry, oil-free air.

b. Procedure.

(1) Observe the instrument air pressure indicator and adjust the system pressure, if required.

(2) Proper operation of compressors and pressure at main receiver tank should be verified regularly.

(3) The maintenance tasks that govern draining accumulated water and maintaining filters, dryers, and other accessories should be performed to insure that air quality is maintained.

278. WATER TREATMENT.

a. Discussion. The heating- and chilled-water makeup water systems have been installed with provisions for treating the water to prevent corrosion and formation of scale in system piping and components. Detailed water-treatment procedures are not included because of the variations in site conditions and differences in water treatments that are recommended by water-treatment service organizations. Scientists have determined that Legionnaires disease is a type of pneumonia that results from a bacteria identified as Legionella. Legionella is found most commonly in domestic hot water systems and in air conditioning condenser water systems. The infection results from inhalation of small water droplets carrying the bacteria. Aerosols containing such droplets may be generated by running taps or showers and during the normal operation of cooling towers and evaporative condensers. The optimum temperature for multiplication of the bacteria was found to be around 37 °C (98.6 °F). The growth of the bacteria decreases at a temperature of 46 °C (114.8 °F). Cooling towers are designed to operate at a temperature that is favorable for the growth of legionella and therefore may require regular biocidal treatment as recommended be a reputable water treatment consultant.

b. Procedure.

(1) A competent water-treatment service organization having local experience shall be selected to develop a treatment program that specifies the water pH level to be maintained and the EPA-approved chemicals, concentrations, frequency of treatment, and procedures for analyzing and treating water.

(2) The treatment program selected shall be documented; and all sampling, testing, and treatment shall be accomplished in accordance with the program.

279. EVAPORATOR PERFORMANCE TEST.

a. Discussion. The evaporator performance test provides a method of checking both the air flow and refrigerant volume in an operating system. Corrective action shall be taken if operation is found outside the limits prescribed in chapter 3.

b. Procedure.

(1) Insure that clean air filters are properly installed in the inlet air duct.

(2) Operate air-conditioning system for at least 30 minutes.

(3) Place thermometers in the evaporator inlet and outlet airstream.

(4) After approximately 10 minutes, take thermometer readings and note the temperature difference. This gives an indication of system performance.

280. EXPANSION VALVE SUPERHEAT ADJUSTMENT.

a. Discussion. Proper operation of a direct-expansion air-conditioner depends on a properly adjusted expansion valve. If the expansion valve is adjusted for too low a superheat, too much liquid will be passed to the evaporator. The suction line will be abnormally cold, and liquid may slug back to the compressor. If the expansion valve is adjusted for too high a superheat, too little liquid will be passed to the evaporator and the suction line will be abnormally warm. Superheat must always be adjusted carefully, using a thermometer and suction line gauge. Do not adjust expansion valves unless a system analysis indicates adjustment is required.

b. Procedure.

(1) Insure that clean air filters are properly installed in the inlet air duct.

(2) Measure the temperature of the suction line at the expansion valve remote bulb.

(3) Install service gauge set. Note suction line pressure and add 2 pounds to the actual reading.

NOTE: Two pounds is an estimated pressure drop added to the actual reading to compensate for suction line loss between the bulb location and the compressor suction valve.

(4) Convert the pressure (actual plus 2 pounds) to saturated evaporator temperature, either from the gauges or by using a temperature-pressure chart. (See Order 6970.3A, Maintenance of Environmental Systems.)

(5) Subtract the temperature obtained in step (4) from the temperature reading taken at the remote bulb location to obtain the superheat temperature.

(6) Compare superheat reading with limits given in chapter 3 and adjust valve setting if necessary.

281. SIGHT GLASS.

Some air-conditioning systems have a sight glass that provides a visual means of checking the amount of refrigerant in the system. The sight glass should be full and clear; however, occasional bubbles are no cause for concern, particularly in mild weather or immediately after the compressor starts. A continuous string of bubbles or a glass only partly filled usually indicates a low charge, and refrigerant should be added to the system. Most sight glasses are provided with a moisture indicator and a dry condition should be indicated at all times. If there is an indication of moisture in the system, the filter-drier should be replaced.

282. THERMOSTATS.

a. Determine that the circulation of air at the thermostat is unobstructed.

b. Check setting and compare with current instruction.

c. Maintain thermostats free of dust and dirt. Use a good grade of paper or a relay contact burnishing tool to clean contact points. Do not use abrasives such as sandpaper or emery cloth. Clean contact points with the electrical power off.

d. Check calibration using a standard thermometer. Refer to manufacturer's instructions for details.

283. COIL CLEANING.

a. Evaporator Coils. Evaporator coils may be cleaned with a stiff brush, compressed air, vacuum cleaner, or a commercial coil cleaner designed specifically for evaporator coils. Before cleaning with compressed air or with a vacuum cleaner, shut off power to the unit and allow the coils to dry before cleaning. When using a commercial cleaner, follow the coil cleaners manufacturer's instructions.

b. Condenser Coils. Air-conditioner condenser coils must be kept clean for good heat transfer. To clean coils, use method best suited for the specific installation. Coils may be cleaned with air pressure, vacuum cleaner, water and detergent, steam, or commercial cleaners. If commercial cleaners are used, follow manufacturer's instructions. Be safe, turn off the electrical power before servicing condensers. If water is used to clean coils, Be sure and protect electrical wiring, fan motors, and controls from water spray.

284. ALGAE CONTROL

Algae may form in a slimy sheet in the condenser or evaporator pans sufficient enough to block drains and weep holes, which will prevent removal of condensate in the normal manner. If this occurs, undesirable water leakage may result. To control algae formation in the pan, cleaning and chemical treatment must be performed. Clean the pan as required and deposit two 2-ounce pantastic tablets (or equal). The tablets will dissolve and should control algae for 6 months. The Virginia Chemical Company manufactures pantastic tablets.

285. MR-CONDITIONER (THRU-THE-WALL) MAINTENANCE.

The best time for executing an air-conditioner cleanup or preventative maintenance program is in the winter. The procedure suggested below is typical although it may not fit all types of equipment. See figure 5-3.

a. Cabinet Front/Assembly. Remove the front panel and proceed as follows:

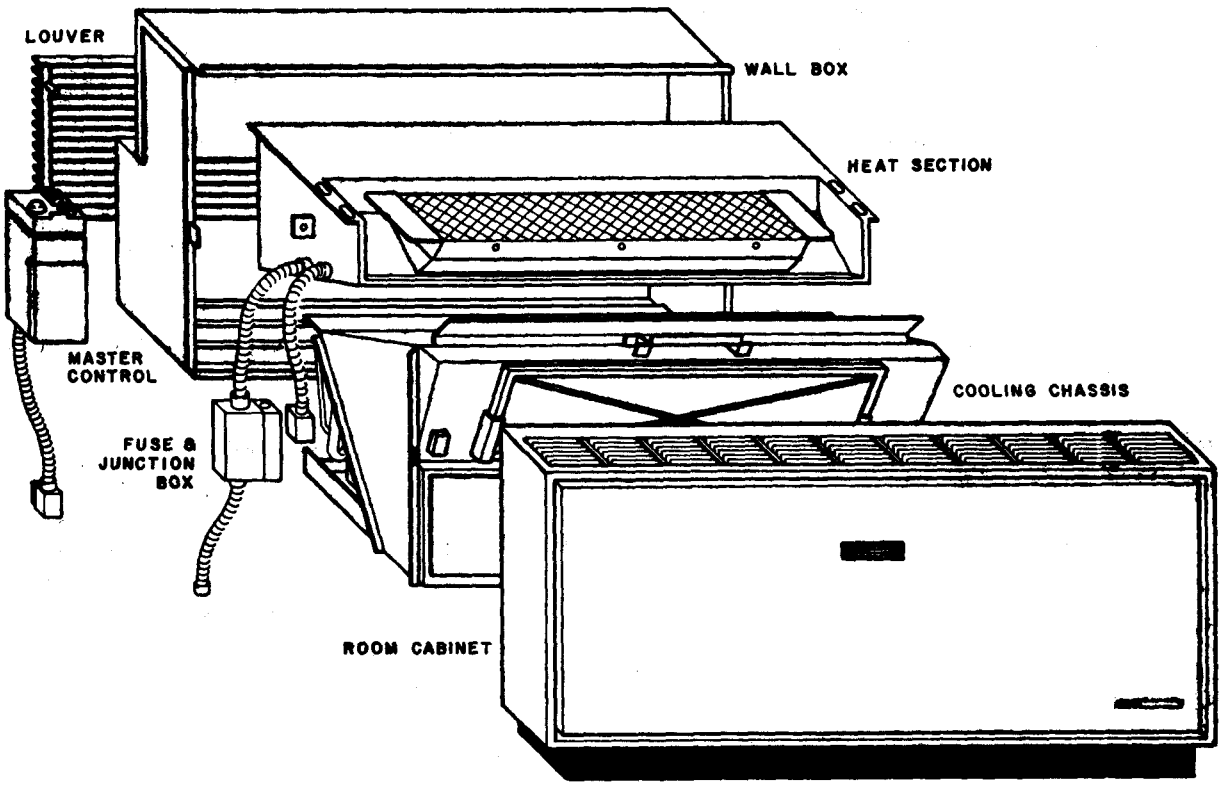


Figure 5-3. Typical Thru-the-Wall Air-Conditioner

(1) Clean inside surfaces of the front panel or assembly with a vacuum cleaner.

(2) Inspect and replace insulation and rubber seals if necessary.

(3) Check any wiring and electrical controls that may be part of the front.

(4) Clean discharge grilles thoroughly. (Do not use paint thinners or similar solvents if grilles are made of plastic.)

b. Cooling Chassis. Remove chassis from the cabinet and carry to a working area. Use a weather plate to seal the wall opening.

(1) Clean all dirt and sediment from the base pan and other parts.

(2) Cover fan motor with bag or "sock" made of plastic or other waterproof material. Wash evaporator coil, condensate pan assembly, and condenser coil with controlled hot water spray using a mild soap or mild detergent and rinse. Do not use a strong detergent that will corrode the aluminum fins of the coil.

(3) Clean condensate drain that leads from evaporator drip pan to condenser base pan or sump.

(4) Dry the equipment thoroughly, especially electrical parts and insulation.

(5) Clean all rust spots with steel wool or emery cloth and repaint as required. Repaint with any rust resistant paint (NSN 8010-00-286-9049 or equal).

(6) Clean insulation with vacuum cleaner and replace if necessary.

(7) Check the weep holes along the rear flange of the base pan, making sure they are open.

(8) Check insulation on the suction tube and replace if necessary.

(9) Operate condenser fan and adjust if necessary.

(10) Tighten loose fastenings.

CAUTION: Do not tighten compressor hold-down nuts on spring-mounted compressors.

(11) If the chassis has a damper solenoid, lubricate ram lightly with any silicone oil or grease.

(12) Clean damper doors and damper linkage and grease lightly.

(13) Inspect electrical wiring and replace or repair if necessary.

(14) Test run the chassis before reinstalling.

c. Cabinet and Heater Assembly.

(1) Clean blower assembly and heating coil thoroughly with vacuum cleaner.

(2) Oil each bearing on fan motor as required, with SAE #10 nondetergent motor oil.

(3) Use steel wool or emery cloth on all rust spots and paint with a protective paint (NSN 8010-00-286-9049 or equal).

(4) Clean insulation with vacuum cleaner.

(5) Inspect electrical wiring and replace if necessary.

(6) Inspect rubber seals and replace or repair if necessary.

(7) Reassemble unit after performing maintenance and check to assure proper operation.

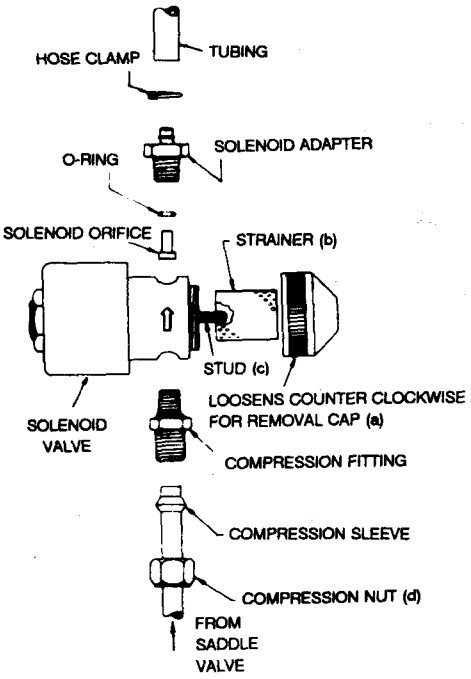
NOTE: Do not use steel wool or brushes to dean stainless steel parts. Use a stainless steel "sponge" instead.

286. SERVICING OF HUMIDIFIER WATER SOLENOID VALVE.

The humidifier is equipped with a teflon orifice and solenoid valve with a built-in water strainer as shown in detail A of figure 5-4. To clean water strainer:

a. Turn off water at saddle valve.

b. Remove cap (a) by turning counterclockwise.



DETAIL A SOLENOID VALVE

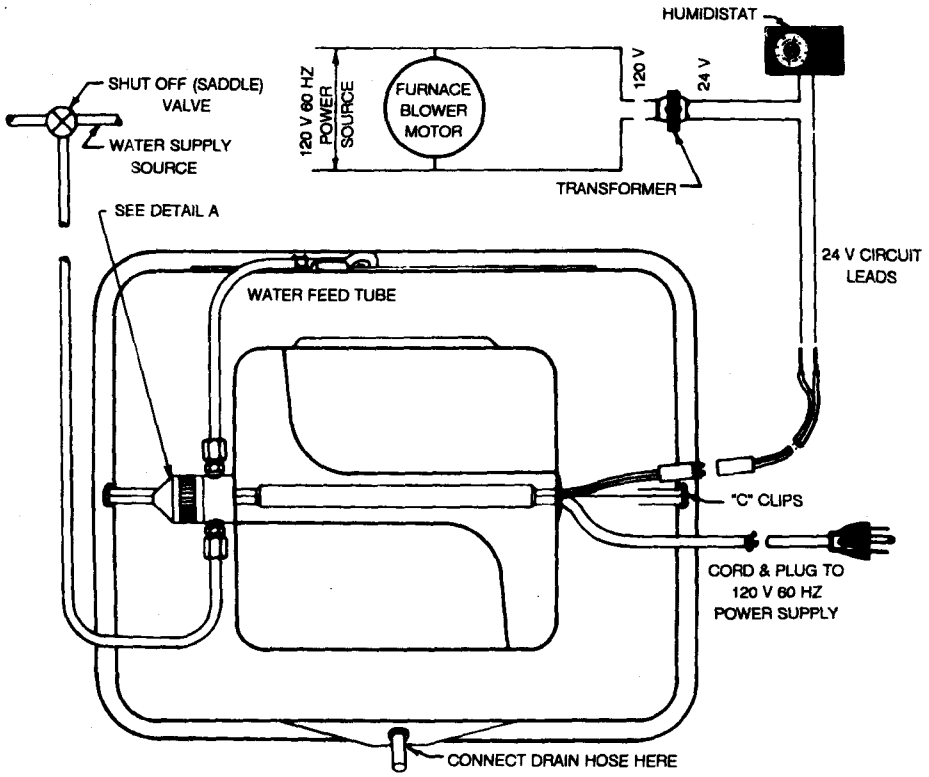


Figure 5-4. Typical Humidifier

c. Remove strainer (b) and flush.

d. Loosen compression fitting (d) above valve and remove copper feed tube. Be sure small opening in orifice at end of feed tube is not dogged. Do not enlarge opening. Reassemble after cleaning.

e. Replace strainer on threaded stud (c). Cap will contour strainer correctly.

f. Replace cap (a), handtighten, and turn on water. Check system for leaks and proper operation.

287. GAS-FIRED DUCT HEATERS.

a. Check that vent pipe is secure and unobstructed.

b. Check burner operation. If evidence of sooting exists, dean burner combustion air ports and adjust combustion air shutters in accordance with manufacturers instructions.

c. Check burner safety limit and operating controls.

d. Check safety pilot operation and clean combustion air port.

288. ELECTRIC DUCT HEATERS.

a. Discussion. Duct heaters usually require very little maintenance. During operation, the resistance coils will remain clean; however, they can collect dust and lint when not in use and could cause a fire the first time the heating system is used after a prolonged shutdown.

b. Procedure.

(1) Inspect all duct heaters for dust and lint accumulation, and clean if required.

(2) Check each heater for electrical shorts to the duct; repair if required.

(3) Check operation of resistance coils after inspection and/or cleaning.

289. ELECTRIC UNIT (SPACE) HEATERS.

a. Discussion. This procedure pertains to portable, wall, and ceiling-mounted electric heaters.

b. Procedure.

(1) Lubricate motor if required.

(2) Check heating element, fan, guards, and louvers, and clean or repair as required.

(3) Inspect mounting for rigidity. If vibration is noted, investigate and correct cause.

(4) If the heater high-temperature protective switch has been activated, investigate cause and correct before pushing reset button. Generally an inoperative fan has caused activation of this switch.

290.-309. RESERVED.

Section 2. ELECTRICAL SYSTEMS

310. MOTOR CURRENT MEASUREMENT.

a. Discussion. Performance of motor driven equipment is directly related to ability of the driving motor to operate within design parameters. Motor current readings, when compared with motor nameplate rating, serve as a practical means of evaluating motor performance. Overloading causes overheating and overheating means shortened insulation life. A motor subjected to a 10 0C temperature rise above the maximum limit for the insulation will have its insulation life halved.

b. Procedure. Using a clamp-on ammeter, take measurement at motor terminals, if accessible. If motor terminals are not accessible, take measurement at motor starter or any other convenient point.

(1) Close probe jaws around each conductor individually and take current reading.

(2) Compare current reading with motor nameplate full load current.

311.-329. RESERVED.

Section 3. MISCELLANEOUS SYSTEMS

330. SUMP PUMPS.

a. Operational Cbeck. Operate the pump and verify the following conditions:

(1) Float responds properly to rising water level in sump.

(2) Unit starts when float switch makes contact.

(3) Pump comes up to speed quickly, maintains constant speed, and does not spark excessively when starting or running.

(4) Pump lowers liquid level (or empties) sump.

b. Clean and Service. Keep the motor, float switch, and starter free from moisture, oil, and dirt. Blow out their interior with air. Keep the settling basin and/or pump basin clean. Remove any sand, mud, and other refuse. Lubricate the pump and motor bearings as required. Use caution since overfilling with oil or packing full with grease will cause excessive heating of the bearing. Do not permit dirt or abrasive matter to get into the bearing.

331. FIRE AND SMOKE DETECTION SYSTEM.

All maintenance checks and procedures must be coordinated with air traffic control and all other individuals, companies, and fire authorities that may be affected by maintenance activities.

a. Testing Fire Alarm Circuit. To test the fire alarm circuit, activate a detector head in each zone. Then check that (1) all the fire alarm audible devices sound, (2) alarm lamp lights, (3) proper zone lamp lights, and (4) the audible alarm devices can be silenced. Also check that the remote annunciators indicate trouble, alarm, and zone signals properly.

b. Testing Fire Detection Devices. Testing of smoke and heat detection devices can be done by manually simulating a hazardous condition near the unit to be tested. A smoke detector can be tested by blowing smoke into the screened chamber on the detector. A heat detector can be tested by using a heat gun.

CAUTION: Never use an open flame to test a heat detector. An open flame can cause fire if combustible material has accumulated on the detector.

c. Smoke Suppression System. The purpose of the exit stair shaft pressurization/air movement system is to keep the stair free of smoke in the event the fire detection and fire alarm systems are activated. To test the exit stair shaft pressurization/air movement system, activate the fire alarm circuit as addressed in paragraph 331(a) and verify that the smoke suppression system in the stair shaft is operational. To verify that the backup power 7-k W/10-kW smoke suppression system engine generator is operational, (1) simulate an ac power failure to the smoke suppression system, (2) activate the fire alarm circuit, and (3) confirm that the smoke suppression system has transferred to the backup power engine generator and the system is operational in the stair shaft.

332. ELEVATORS.

a. Elevator Controls and Relays. Inspect all electric controls for loose terminals. Inspect all relay contacts for corrosion, pitting, and burns.

b. Elevator Control Buttons. The control buttons in the car operating panel and call stations should be checked for freedom of movement. These buttons should be inspected periodically; replace the contacts if they have become worn or burned.

c. Elevator Door Linkage. Lubricate door moving parts. Adjust linkage if doors do not close properly. Take care to adjust both doors equally.

d. Elevator Hoistway. Inspect the hoistway for loose bolts, cams, and other operating parts. Check the guide shoes for wear and adjust or replace as necessary. Lubricate shoes with nondetergent motor oil.

e. Elevator Hoistway Pit. Keep the pit clean of oil and debris. Use safety supports in the pit before performing any work in the pit. These supports limit the lower travel of the elevator car thus providing safe clearance for maintenance personnel. Make sure that the supports are removed when the work is completed.

f. Inspection. Each FAA elevator should be inspected and certified annually as required by the American Standard Practice for the Inspection of Elevators, Inspectors Manual ANSI A17.2. See the latest edition of Order 6950.12A, Elevator Maintenance and Inspection Procedures, for details.

g. Hoisting Machine. Check for correct oil level. Add oil if necessary to maintain proper level per manufacturers' instructions.

h. Door Operator Belts. Check for worn or burned belts. Replace belts if necessary and adjust for adequate tension to avoid slipping.

i. Belt Tension. Before attempting to adjust belts, shut off power to the elevator motor. Refer to instruction book for procedure for checking pumping machine belt tension. If belts must be replaced, they should be replaced in matched sets.

j. Elevator Pumping Machine. With the elevator at the level recommended by the manufacturer, check for proper oil level in the reservoir tank. If necessary, add more oil. Erratic operation of valves in the manifold system usually results from a worn 0-ring seal in the valve piston. Tighten the packing in case of excessive oil leakage around the cylinder. Take care not to tighten the packing too tight. Should it become necessary to replace the packing, bring the elevator to rest on the pit supports. Do not loosen the packing gland bolts until the elevator is resting on these supports.

k. Fuses. Inspect fuses for proper alignment and seating in fuseholders. Replacement fuses must be in accordance with sizes as indicated on manufacturers electrical schematics.

l. Hydraulic Hoses. Visually inspect hydraulic hoses for signs of deterioration, such as, frayed or damaged outer covering, cuts, abrasions and weakness due to ageing that could cause the hose to rupture when in service. Repair or replace hydraulic hoses as required to ensure safe elevator operation.

333. HOT WATER HEATERS.

a. General. To assure long life and efficiency, the water tank must have small amounts of water drained periodically. Open the drain valve and allow the water to run until if flows clean. This will help prevent sediment buildup in the tank.

b. Pressure Relief Valve. The temperature and pressure relief valve shall be checked to insure operation. Lift the lever at the top of the valve several times until the valve seats properly and operates freely.

c. Cleaning Electric Heating Element. The heating element is located in the tank. Scale or lime accumulates on the element more frequently in hard water areas. When lime or scale accumulates on the element, excessive hissing sound, buzzing sound, or retarded heating occurs. This indicates that the heating element should be cleaned with a wire brush. Thoroughly scrape and brush the element to remove all residue.

334. CENTRAL VACUUM SYSTEM.

a. Cloth Bags. Remove the cloth bag and thoroughly shake debris from the bag. This cloth bag prevents dirt or grime from entering into the motor.

CAUTION: Never wash or turn the system on without having the clothbag in place. Never wash or throw cloth bag away.

b. Foam Filters. A cartridge-type air filter is located in the bottom of the collection center. This filter is designed to protect the motor from accidental damage due to ruptured or misplaced filter bags. Note that the metal side of this filter shall face upward and the foam ring down. To clean, simply remove and rinse thoroughly with water, let dry, and replace in original position.

CAUTION: Should filter become damaged or separated from metal disc, replace entire assembly at once.

c. Damaged Hose. When the flexible vacuuming hose develops leaks, it can easily be repaired. If the leak is located near the rubber sleeve, with scissors cut around the hose at the point of the leak. The inside of the rubber sleeve has a thread that matches that of the hose. Rethread hose into rubber sleeve and repair is complete. If the leaks occurs near the middle of the hose, it must be replaced.

d. Loss of Suction. If suction is insufficient at the hose end, follow these steps:

(1) Remove the hose and test the inlet suction. If the suction is good, the hose is clogged. By reversing the hose and holding it to the inlet or by inserting the hose into the motor exhaust, the reverse airflow will blow out the obstruction. However, if this should not work, then use a plumber's wire "snake" to remove the obstruction. (Use caution to avoid puncturing the hose.)

(2) If the inlet being tested also has poor suction, test a second inlet. If good suction is found at this second inlet, then use the plumber's "snake" or a piece of strong stiff wire with a hook bent into it to remove the obstruction at the original inlet.

(3) If the suction power is poor at the second inlet, then test the utility inlet located on top of the power unit. If the suction is poor here, turn off the system and replace the disposable bag.

NOTE: If suction power is still poor after having followed the above steps, see instruction book.

e. Obstruction Check. Beginning at the collection center on the ground floor, open the outlet and visually inspect for obstructions. Check duct by pushing a flexible steel tape (snake) 8 to 10 feet long (2.44 to 3.05 meters) into the duct. Repeat at each floor level.

335. INTERCOM SYSTEM.

a. Noise and Hum Corrections. Hum, noise, or other interference may be produced by ATCT apparatus, office equipment, motors, or the facility's power supply. It may be picked up by the voice lines connecting the speaker stations and amplifier in the master unit when the talk/listen switch is in the listen position. Inter-station voice lines must always be twisted pair wires, for minimum pickup of interference. The transposing effect eliminates hum or noise picked up by inter-station wiring. Ascertain that the connecting cable is not grounded to any pipe, conduit, or metal surface by moisture or direct contact. This may unbalance the canceling effect of the twisted wire and cause noise, hum, crosstalk in the system. In extremely noisy locations where the noise is picked up by the inter-station wiring, it may be necessary to install shielded pairs of wire between the speaker station and the master station. Never use a single shielded wire for this purpose. Use the two-wire shielded cable, grounding the shield at one point near the center of the length of cable or near the system master station.

b. Voltage Checks. Many conditions causing abnormal operation of the equipment can be detected by taking voltage measurements at critical points in the circuit. Measurements should be made with a vacuum-tube voltmeter (vtvm) or a volt ohmmeter rated at least 5000 ohms per volt and compared with the voltages shown on the equipment schematics. A measured voltage, within 10 percent of the readings shown on the schematics, can be considered to be within tolerance and does not necessarily indicate an abnormal condition.

c. Resistance Checks. Resistor values are shown on the schematics; a tolerance of 10 percent is permissible. Usually a change in resistance values will show up as changes in voltage readings also.

336. CERTIFIED INSPECTION OF PRESSURE TANKS.

In addition to the annual pressure tank inspection test, tests shall also be performed whenever the pressure tanks or any appurtenances are modified; when repairs/alterations are made; or when routine maintenance reveals evidence of corrosion or physical damage to the extent that integrity of the tank may have been affected. Certificate inspections and tests shall be accomplished by obtaining the services of an inspector who is certified and licensed to perform inspections in accordance with the inspection code of the tank inspectors, the American Society of Mechanical Engineers (ASME) Code and/or applicable state or local laws and ordinances. Pressure tanks shall be prepared for inspection to the extent deemed necessary by the inspector. Also, if required, hydrostatic testing shall be conducted for the inspector by securing the services of a reputable concern specializing in this field. This is recommended since the service is not likely to be needed frequently enough to justify the expense of procuring the needed test equipment or in training of personnel to perform it. The hydrostatic test crew shall consist of at least two members and the inspector. The test shall be conducted as follows:

a. The maximum hydrostatic pressure applied shall not exceed one and one-half times the maximum allowable working pressure of the tank.

b. During the test, the safety relief valve or valves shall be removed or each disc shall be held to its seat by means of a testing clamp and not by applying additional load to the spring with the compression screw.

337. FUEL TANK MARKING.

a. Below-Ground Tanks. The filler caps should be painted in accordance with the American Petroleum Institute equipment marking color system appropriate for the type and grade of fuel to be supplied to the facility. See figure *5-5.* The symbol for gasoline is a circle. Leaded gasoline is indicated by a solid red circle for the distributer's highest octane, blue for the medium octane, and white for the lowest octane. Unleaded gasoline is indicated by a cross on the solid background. A white cross on the red circle signifies the highest octane of unleaded gasoline, a white cross on the blue circle is the middle grade, and a black cross on the white circle is the lowest octane of unleaded gasoline. A hexagon symbolizes a distillate fuel, with yellow indicating diesel. Diesel filler caps shall be painted yellow and for further identification may have an identifying letter "D" painted on the cap. A product containing an extender, such as alcohol, is designated by the addition of a border around the symbol, black around white and white around other colors. The extender examples shown in figure *5-5* would indicate middle gasohol and diesahol.

b. Above-Ground Tanks. The filler caps should be painted the same as indicated for below-ground tanks. In addition, a 12-inch color-symbol indicating the type of fuel being used should be painted in a conspicuous place on the side or end of each tank. For further identification, the type of fuel may be identified with 2-inch lettering directly below the color symbol.

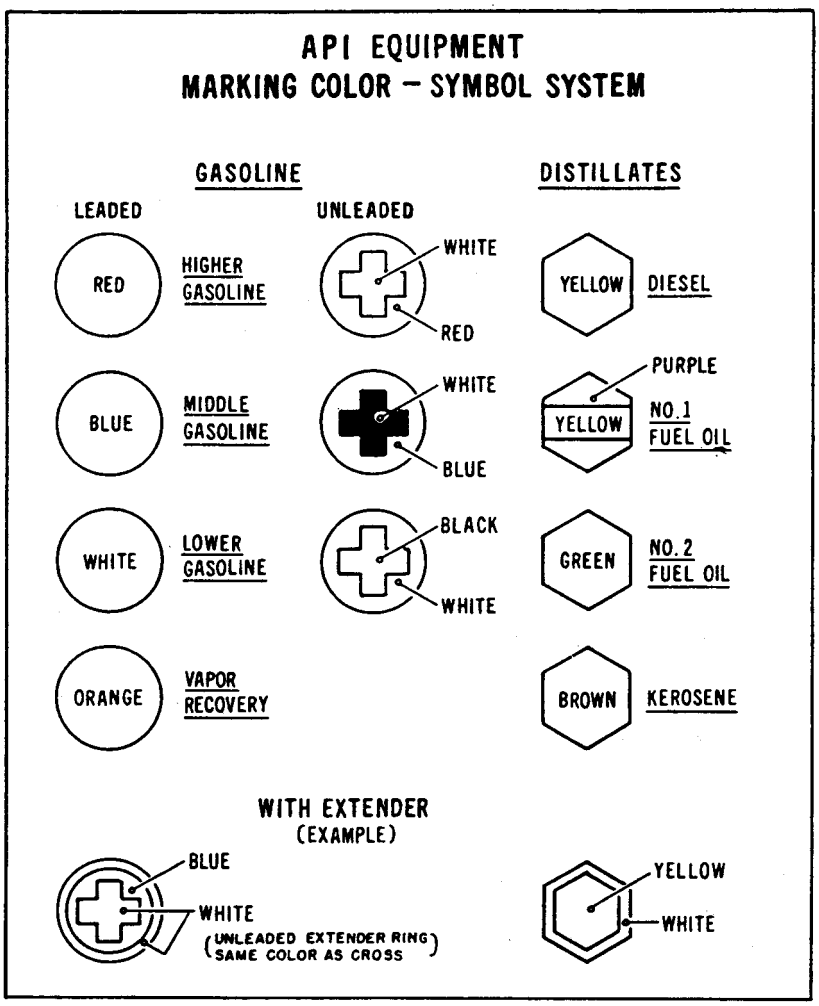


Figure 5-5. API Equipment, Marking Color-Symbol System

338. CONVENIENCE UNITS.

a. Range. Turn on burners. Observe that the "burner on" indicator illuminates. If any burner fails to operate, refer to instruction book.

b. Refrigerator. Listen as the refrigerator compressor cycles on and off. The compressor should run smoothly without any excessive noise.

(1) Use vacuum to clean condenser.

(2) Refer to instruction book if any operational difficulties are detected.

c. Microwave Oven. Refer to the manufacturers instruction book for maintenance procedures and requirements.

d. Miscellaneous Convenience Equipment. Refer to manufacturers instruction books.

339.-349. RESERVED.

Section 4. BUILDING SYSTEMS

350. FACILITY DESIGNATIONS AND SIGNS. *

a. Check that warning and facility designation signs are in place and are not faded, rusted, or damaged. Repair or replace signs as required.

b. Inspect sign fasteners and replace, tighten, or adjust as required.

c. Replace sings that have weathered or become unreadable.

351. LADDERS, STAIRWAYS, AND SERVICE PLATFORMS.

a. Inspect ladders, stairways, and service platforms for damage or deterioration; repair all defects.

b. Examine ladder rungs, steps, and walking surfaces for irregularities that might cause personnel to trip. Check all handrails. Repair any defects noted.

c. Examine structural materials such as framing, decking, and railing for damage and deterioration. Repair or replace defective materials.

d. Inspect members for missing or loose fasteners. Tighten all loose fasteners and replace all those that are missing.

* **352. WITHDRAWN--CHG 1**

*

353. ROOFS.

a. Inspect underside of roof for stains, spots, and discolorations that indicate water leakage. Check roof exterior for cracks, splits, cuts, etc., paying particular attention to flashing and areas where leaks were indicated during the interior inspection. Repair leaks if feasible, otherwise report defects.

b. Inspect all roof components for deterioration or damage. Make repairs where feasible, otherwise report defect.

c. Examine roof for evidence that water ponding has occurred indicating improper roof drainage. Report any defects that are detectecd.

d. Clean dirt, leaves, gravel, etc., from roof drains, gutters, and downspouts. Remove all foreign materials from roof deck.

e. Adjust and secure all loose or improperly positioned metal trim, gutters, downspouts, drains, and other roof hardware.

f. Reposition and level any tilted splash blocks.

354. WALLS.

a. Inspect exterior wall materials such as siding, panels, concrete, etc., for deterioration. Make repairs where feasible, otherwise report defects.

*

b. Examine interior wall materials such as gypsum board, paneling, masonry units, tile, etc., for deterioration. Replace or repair damaged materials.

c. Examine caulking for deterioration. Replace defective caulking where feasible, otherwise report defects. Use Federal Specification No. TT-S-002, Type 2 gun-grade single-component sealant.

d. Check walls and ground floor for termite infestation. Exterminate termites if detected.

355. CEILINGS.

a. Inspect ceiling materials for damage and deterioration. Repair areas as required.

b. Repair ceiling support system and re-level where ceiling has sagged.

356. DOORS AND DOOR HARDWARE.

a. Check doors for proper operation. Insure that they do not stick or bind. Adjust doors as required.

b. Inspect exterior door, frame, and threshold for signs of water and air leakage. Replace or repair faulty weather stripping as required.

c. Check door hardware such as locksets, latches, closures, and hinges for proper operation. Repair or replace defective hardware.

d. Clean and lubricate door locksets, latches, hinges, and closures, if necessary.

e. Inspect drain holes in bottom of hollow metal doors. Open these holes if they have become clogged.

f. Check door surface, sides, edges, and corners for cracks, separation, and deterioration. Repair defects as required.

g. Examine door, door framing, and trim materials including glass for damage or deterioration. Repair or replace defective materials.

h. Inspect door thresholds for deterioration and water leakage. Repair or replace damaged thresholds.

357. WINDOWS.

a. Check window hardware such as hinges, latches, locks, etc., for proper operation. Repair or replace damaged hardware.

b. Examine window frames for deterioration. Repair or replace damaged material.

c. Remove broken window panes and reglaze panes as required.

d. Inspect all frames including those in the cab for signs of water and air leakage. replace defective weather stripping or caulk as required. Use Federal Specification No. TT-S-002, Type 2 gun-grade single-component sealant.

358. TRAP DOORS OR HATCHES.

Check trap doors or hatches for water tightness and ease of operation. Adjust or repair leaking, sticking, or binding doors.

359. ANTENNA MOUNTS AND HARDWARE.

Check security of antenna support hardware. Tighten or repair supports as required.

360. BOILER/HEATER STACKS.

Inspect gas-fired heater or boiler stacks for obstruction. Remove rust and corrosion and repaint areas as required.

361. PAINTING.

a. Examine condition of paint or other protective coating of tower and appurtenances, and report condition.

b. Wire-brush areas where paint is loose or where rust has developed. Treat rusted areas with primer equal to Ospho Rust Inhibitor, Cleveland, Ohio (NSN 6850-00-5029447). After surface is prepared, perform minor or touchup painting as required.

362. FOUNDATIONS.

a. Examine foundation visually for cracks, spalling, uneven settling, and heaving. Report all defects noted.

b. Inspect site for adequate drainage. Correct problem if feasible, otherwise report defect.

* **363. WITHDRAWN--CHG 1**

364. WEATHERPROOFING.

a. Horizontal and Vertical Seams (Joints).

(1) Weatherproofing Tape. A flexible pressure-sensitive, weather-resistance tape equal to 3M Company No. 838 has proved to be effective for sealing water leaks on ATCT's. Where required, apply the tape in accordance with the manufacturer's instructions. Before application, clean the surface of all dust or debris and insure that it is dry. If additional tape adhesion is desired, spray the surface with tape primer equal to 3M Company tape primer. To match existing color on ATCT's, the tape must be black or painted black. Dupont's latex paint No. 40 and No. 42 (or equal) should be used to paint the tape after it is installed. The 3M waterproofing tape is available in widths of 1/2 inch, 1 inch, 1 1/2 inches, 2 inches, or 3 inches by 72 yards long. The 3M Company weather-proofing tape (No. 838) and tape primer (for pressure sensitive tapes) is available through any local 3M Company representative, distributor, or company.

(2) Caulking. A special caulking compound, Federal Specification TT-S-00230, Type 2 gun-grade singlecomponent sealant, is available at the FAA Logistics Center. On low-activity-level ATCT's, caulking is recommended for the following areas:

(a) Cab windows.

(b) Enclosure seams on rooftop and thru-the-wall air-conditioners.

(c) Sealing around vents and louvers.

(d) Corner seams on the ATCT.

b. Roof. Many roofs eventually require patching. * A quick setting plastic asbestos tar has proved to be effective for patching and sealing water leaks. Apply in accordance with Order 6930.25A and manufacture's instructions.

365. RUST PREVENTION.

Rusting and corrosion of metal on ATCT's occurs more frequently in some locations than others. For metal surfaces that require restoration, follow these steps:

a. Prepare surface by vigorously brushing rusted areas with a wire brush.

b. Clean away excess debris from wire brushing.

c. Apply a material equal to OSPHO primer (NSN 6850-00-502-9447) manufactured by

The Skybryte Co.
2135 Perkins Avenue
Cleveland, Ohio 44114

d. Repaint the surface in accordance with manufacturer's instructions.

APPENDIX 1. DEFINITIONS AND METRIC CONVERSION

AIRPORT OPERATION. Either a landing or a takeoff at the airport. A low approach below traffic pattern altitude or a touch-and-go operation shall be counted as both a landing and a takeoff; i.e., two operations.

AIRPORT TRAFFIC CONTROL TOWER (ATCT). A facility established on an airport to provide air traffic control service on, and in the vicinity of, that airport.

BASE BUILDING. The structure (usually attached to the base of a tower shaft) that houses ATCT facility support space.

CONTROL CAB. A glass-enclosed observation cabin from which air traffic control specialist observe, communicate with, and control airport traffic.

DRAINAGE SYSTEM. The system of pipes, ditches, and structures by which surface or subsurface waters are collected and conducted.

IFR TOWER. An airport traffic control tower that provides approach control service.

INSTRUMENT FLIGHT RULES. Federal air regulations that govern the procedures for conducting instrument flight.

JUNCTION ROOM. The space in a tower shaft immediately below the control cab.

TERMINAL RADAR APPROACH CONTROL (TRACON). A terminal air traffic control facility collocated with an ATCT. It uses radar data acquisition and air-to-ground communication equipment to provide approach and departure traffic control services under IFR conditions. It is a room containing equipment and personnel for the operating positions that control IFR traffic.

TERMINAL RADAR APPROACH CONTROL IN TOWER CAB (TRACAB). A terminal air traffic control facility that combines typical control cab operations with TRACON functions, in a cab, for low-activity radar facilities.

TOWER SHAFT. The freestanding vertical structure of an ATCT, which supports the control cab 40 to 300 feet above ground level (AGL), which may house HVAC systems, electronic equipment, administrative space, operation space, an elevator, and/or stairwell, etc.

VFR TOWER. An airport traffic control tower that does not provide approach control service.

VISUAL FLIGHT RULES (VFR). Federal air regulations that govern the procedures for conducting flight under visual conditions.

Table 1. METRIC CONVERSION

TEMPERATURE. To convert degrees Fahrenheit to degrees Celsius:

$t\,°C = (t\,°F - 32)/1.8$

LENGTH.

To convert:	To:	Multiply by:
inches	Centimeters	2.54
feet	Meters	0.3048

PRESSURE.

To convert:	To:	Multiply by:
pound-force per square inch (psi)	Kilograms per square centimeter	14.2

VOLUME.

To convert:	To:	Multiply by:
pints	liters	0.473
quarts	liters	0.946
gallons	liters	3.785

APPENDIX 2. ABBREVIATIONS

AC: air-conditioning

AF: airway facilities

AGL: above ground level

AHU: air handling unit

ALS: approach light system

ARTS: automated radar terminal system

ASDE: airport surface detection equipment

ASR: airport surveillance radar

AT: air traffic

ATC: air traffic control

ATCBI: air traffic control beacon interrogator

ATCT: airport traffic control tower

ATIS: automatic terminal information service

BRITE: bright radar indicator tower equipment

CAB: control cab

COMM: communication

DACOM: data communication

E/G: engine generator

EMT: electrical metallic tubing

ET: electronics technician

FAA: Federal Aviation Administration

FAR: Federal Aviation Regulation

FDEP: flight data entry and printout

GFET: general facilities equipment technician

HOPPI: horizontal plan position indicator

HVAC: heating, ventilating, and air-conditioning

IB: instruction book

IFR: instrument flight rules

ILS: instrument landing system

MDP: main distribution panel

MDPN: main distribution panel non-essential

MSL: mean sea level

NAVAID: navigational aid

NAVCOM: navigation communication

NEC: national electrical code

NEMA: National Electrical Manufacturer's Association

NFPA: National Fire Protection Association

OSHA: Occupational Safety and Health Administration

PCS: power conditioning system

PPI: plan position indicator

RAPCON: radar approach control (USAF)

TRACON: terminal radar approach control

VFR: visual flight rules

U.S. Department
of Transportation

**Federal Aviation
Administration**

Memorandum

Subject: INFORMATION: Suggested improvements to Order 6480.8A, Maintenance of Airport Traffic Control Towers

Date:

From: _____
Signature and title

Reply to
Attn. of: _____
Facility Identifier
AF Address

To: Manager, National Airway Systems Engineering Division, AOS-200

Problems with present handbook:

Recommended improvements:

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